ŠIAULIAI STATE UNIVERSITY OF APPLIED SCIENCES

PROFESSIONAL STUDIES:
Theory and Practice

2021 / 9 (24)

Šiauliai, 2021

CONTENT

RESEARCH OF CHANGE IN FUEL CONSUMPTION USING ECO-DRIVING RULES

Manvydas Bagavičius
Šiauliai State University of Applied Sciences
Lithuania

Annotation
Research examines the fuel consumption of a gasoline engine. Eco-driving is described in theoretical terms. The making of an additional fuel tank system is described which is used to accurately determine fuel consumption. Routes A-E have been developed and tested by driving the car conventionally and in accordance with the principles of eco-driving. Fuel consumption for all routes was obtained and fuel savings were calculated. The ecological and financial benefits of eco-driving have been calculated.
Keywords: Eco-driving, ecology, fuel consumption, petrol engine, fuel system.

Introduction
Transport is an integral part of the modern world. The better developed the transport system, the faster the cargo will be delivered and the passengers will reach their destination. All of this comes at a cost, as vehicles are one of the main sources of air pollution and a major contributor to climate change. To avoid the consequences of climate change, various strategies are being developed to reduce air pollution, one of which is eco-driving.

Eco-driving (efficient driving) is a modern responsible and rational driving style, where the driver pays attention to the traffic flow and is safe; the car can be operated without repairs for a longer time and uses less fuel. [1].

There are many different steps you need to take to adapt your eco-driving style to driving, both before and after driving, as each will reduce your overall fuel consumption.

Purpose of the research. To make an additional fuel tank system to measure the amounts of fuel consumed on the routes A-E and then calculate the ecological and financial benefits of eco-driving.

1. Eco-driving rules, principles and benefits
Benefits of eco-driving:
• Security
- Increasing road safety;
- Improving drivers driving skills.
• Environmental
- Reducing greenhouse gas (CO_2) emissions;
- Reduces local air pollution;
- Noise level is reduced.
• Financial
- Fuel / money savings (long-term savings of 5–15 %);
- Lower vehicle operating costs;
- Lower accident costs.
• Social
- More responsible driving;
- Less stress while driving. [1]

The concept of eco-driving is different from definition to definition but the common goal is to reduce the negative impact from driving. [6]

The driving should be done smoothly and without stress to help reduce sudden changes in velocity which often means that energy was wasted in order to get the vehicle moving in a short burst. [5]

To achieve the benefits of eco-driving, certain rules and principles need to be applied. They can be:
• Proper gear shifting. Each car will have a different engine speed limit, but the limit should not exceed 2000 rpm when driving. While driving at 50 km/h fourth or fifth gear should be engaged.

- Maintaining a constant speed while driving. The speed of the car must be as constant as possible while driving. Fuel consumption will be lower if the accelerator and brake pedals are pressed as infrequently as possible. The highest fuel consumption is when the car accelerates.
- Environmental monitoring. When driving, you should observe what is happening in front of and around the car. If an obstacle is visible, it will be possible to bypass it and there will be no need to stop, which would increase fuel consumption.
- Stopping the car without the brake pedal. If the driver can see an obstacle in front that will force the car to stop, such as a red traffic light, the driver should release the accelerator pedal and roll with gear engaged until he rolls to the obstacle. There is a chance that when the green traffic light comes on, the car will not have stopped yet, so the car will need less fuel to accelerate again.
- If the engine is on, car should drive and not stand still. If the car has stopped and will be there for 1-2 minutes or more the engine should be switched off.
- Electrical devices in the car. Electricity, for devices such as: car radio, air conditioner, electric windows, heated seats and others is obtained by burning additional fuel. The fewer appliances switched on, the lower the fuel consumption.
- Car maintenance. The car should be serviced regularly. Regular replacement of engine fluids, spark plugs, belts, filters and other components will help the engine to operate optimally.
- Tire pressure. It is very important to constantly check the tire pressure. Tire pressures can significantly increase fuel consumption.
- Car smoothness. The sleeker the car, the lower the air resistance with the air, thus reducing fuel consumption. The car may become less sleek due to the bike racks, trunks, cargo, etc. attached to the car. Even a car that is washed regularly will be smoother than a dirty car.
- Car weight. The heavier the car, the more fuel it will consume. The car should be inspected and cleaned of unnecessary items / loads.
- Route planning. An optimal route should be established before departure. Using modern technology, it is possible to create a route without road repairs or additional unwanted stops. It should be remembered that the shortest route will not always be the fastest or most environmentally friendly.

2. Research on change in fuel consumption using eco-driving rules

While searching for the information on the topic of eco-driving, several types of studies have been found that attempt to compare the fuel consumption of conventional driving and eco-driving. The method of determining the change in fuel in those articles often raises many questions. There are two main ways in which the change in fuel was calculated. They can be named as follows:

1. Full fuel tank test;
2. Investigation of on-board computer readings.

The car selected during the full fuel tank test is filled with a full tank of fuel. After the car makes a certain route it goes to the gas station and refills the full tank. The amount of fuel required to refill the fuel tank a second time is counted as the fuel consumption for this route.

During the investigation of on-board computer readings, the car needs to be equipped with on-board computer. Current fuel consumption readings must be recorded and from this data the fuel consumption of the certain route can be calculated.

Both methods are quite inaccurate. In the first case it is impossible to fill the fuel tank with the same amount of fuel two times in the row. The amount of fuel in full fuel tank can vary from a few tens to several hundred milliliters or even a liter, so it is not clear how much fuel was burned during the certain route.

In the second case, using on-board computer readings, the results are also inaccurate because fuel consumption is a constantly changing dimension. Each press of the speed or brake pedal increases or decreases the consumption and that data changes every second and taking the average consumption of one route will result in very inaccurate results.

In order to carry out the study as accurately as possible and to determine the difference between the fuel consumption of conventional driving and eco-driving the idea was to produce a fuel system that would allow getting accurate results of fuel consumption. A separate fuel tank was used for this purpose which could be weighed before and after the test to find out exactly how much fuel was burned during the route. The study was conducted on five different routes. Each route consisted of two journeys, one conventional, the other applying the principles and rules of eco-driving.

3. Peugeot 206 technical specifications and the making of new fuel system

To carry out this research a car was purchased and an additional fuel tank was installed in it. By doing that it was possible to determine the exact fuel consumption. Several requirements have been raised for a car for research:

• Engine by fuel type - petrol;
• Good access to the in tank fuel pump;
• Construction of the in tank fuel pump.

A gasoline engine has been chosen because the pumps in the diesel fuel system are more vulnerable. Also, fuel in diesel systems often settles in the fuel tank and because of the air stuck in the fuel system lines it is harder to start the car. The fuel pump in the tank in this model is mounted under the rear seat on the right side. The pump housing can be seen by lifting and removing the metal cover (Fig. 1).

Fig. 1. In tank fuel pump

There is an electrical connection at the top of the pump and two fuel lines - supply and return. The car met all the requirements that were raised before it was purchased and was suitable for this research. More technical data of the purchased Peugeot 206 is given in Table 1.

Table 1

Peugeot 206 technical specifications [4]

Year of manufacture	2000
Engine displacement, cm3	1124
Fuel type	Petrol
Engine power, kW (HP)	44 (59)
Maximum speed, km/h	158
Acceleration 0-100 km/h, sec	15,4
Drive wheels	Front
Gearbox type	Mechanic
Number of gears	5
Weight, kg	885
Fuel consumption in the city 100km, l	8,3
Fuel consumption on the highway 100km, l	5,2
Average fuel consumption 100km, l	6,2
Fuel tank capacity, l	50
CO2 emissions, g/km	148

The data in the Table 1 show that the car has a 59-horsepower engine and weighs only 885 kg. The average fuel consumption per 100 kilometers is 6.2 liters. When registering this car,

the pollution tax was calculated with the registration tax calculator and was €0. If the tax had been set on the basis of technical data that CO2 emissions were 148 g / km, the pollution tax would have been €30,06.

When choosing a new fuel tank, its external and internal dimensions were taken into account. The inside of the tank had to be large enough to accommodate the fuel pump and from the outside the tank had to be as compact as possible so that it could be conveniently connected, disconnected, secured and lifted out of the car to be weighed. A 12-liter tank was purchased. In order to install a fuel pump in it, it was necessary to modify its cover by cutting a hole in it. The tank is shown in Figure 2.

Fig. 2. A 12-liter tank for fuel

A used fuel pump was found and bought, which was removed from the same car Peugeot 206 with a 1.1-liter engine. This pump was used in the new fuel tank. Fuel pump mounted in the lid of the tank is shown in Figure 3.
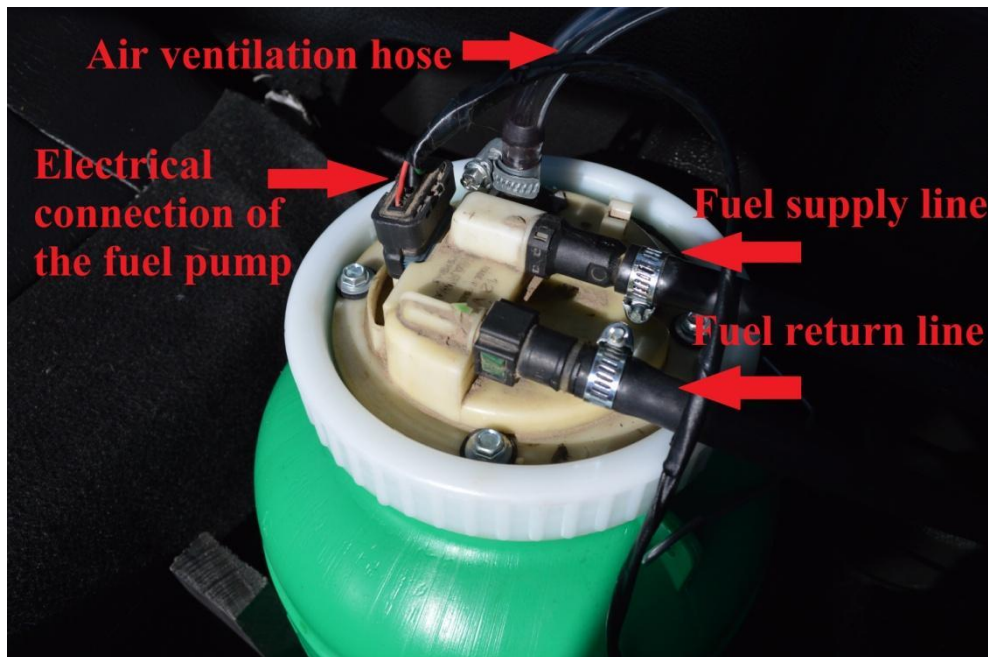
Fig. 3. Fuel pump mounted in the lid of the tank

A separate fuel tank was mounted in the rear of the cabin on the right side under the "passenger's feet". This location was chosen because it was the closest location to the location where the original fuel pump was installed. The only thing that was modified on the car is a second electrical connection soldered to the original fuel pump power cord. This was chosen to do because the original cable was too short to connect to a new fuel tank. It was extended by about 50 centimeters. The fuel supply and return lines were also too short so 50 centimeters extensions were made. New fuel system is shown in Figure 4.

Fig. 4. New fuel system

Fuel tank ventilation was also installed. A transparent hose was used for ventilation, one side of which was connected to the tank and the other end led out through a hole in the body to the outside of the car. In order to connect the new fuel tank, it was necessary to disconnect the original fuel supply connections and the electrical connection, then to connect the extensions to the car's fuel supply lines and to connect the extended electrical connection to the new pump. A frame was made of wooden beams in which the new fuel tank was placed to keep it stable. Connected new fuel tank is shown in Figure 4.
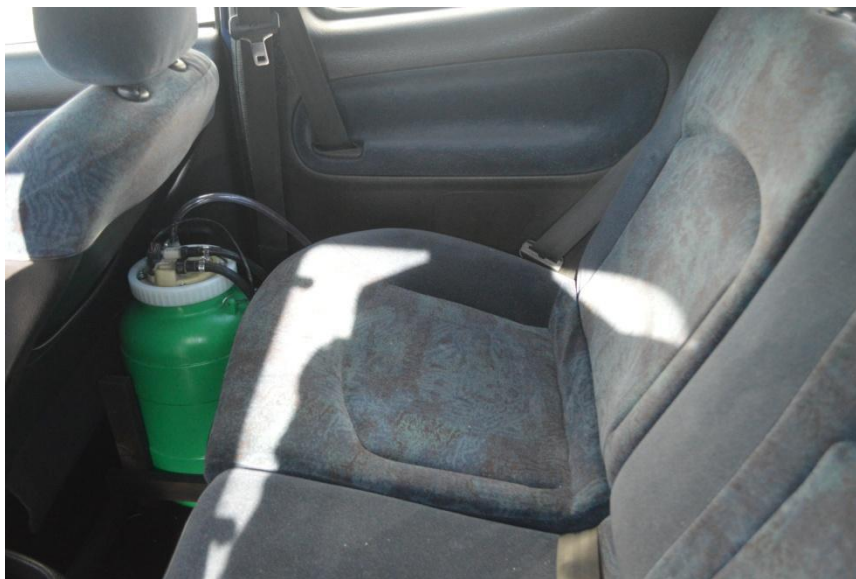
Fig. 4. New connected fuel tank

4. Description of routes used in the research

Routes were made in the city, on the country roads, as well as on paved asphalt concrete roads and gravel roads and on roads with different speed limits from 30 to 90km/h. The aim was

to obtain different fuel consumption figures as some routes had more traffic lights and others had fewer. There were also gravel sections on some routes while on other roads there were country roads with 90km/h speed restrictions.

Each route were driven two times, one time conventionally and second time using eco-driving rules. It was practically impossible to drive them with the same number of stops. Stops can be caused by unregulated pedestrian crossings, traffic lights, and buses leaving the bus stops, drivers driving on one lane roads much slower than it is allowed and so on. There have been cases where on conventional driving routes there were practically no stops and on eco-driving route it was necessary to stop at almost all traffic lights. Such stops and accelerations increase fuel consumption.

Five different routes A - E were used in the research. The rides were started from the 6th Metal Garage Community on Gegužių Street because the car used in the investigation was stored there. Information about the routes A-E is given in Table 2.

Table 2

Routes A-E information

Route name	Route length, km	Route road surface	Possible stops on the route	Speed limits on the route, km/h
A	8,5	Asphalt concrete	21	50, 70
B	6,4	Asphalt concrete, gravel road	5	40, 50, 70
C	17,1	Asphalt concrete, gravel road	41	30, 50, 70
D	23,4	Asphalt concrete	51	30, 40, 50, 70, 90
E	9,3	Asphalt concrete	21	50

Total distance of routes A-E is 64.7 kilometers. This distance was covered twice: by driving conventionally and by applying eco-driving rules. Map of routes A-E is made by the Google Maps application and is shown in Figure 5.
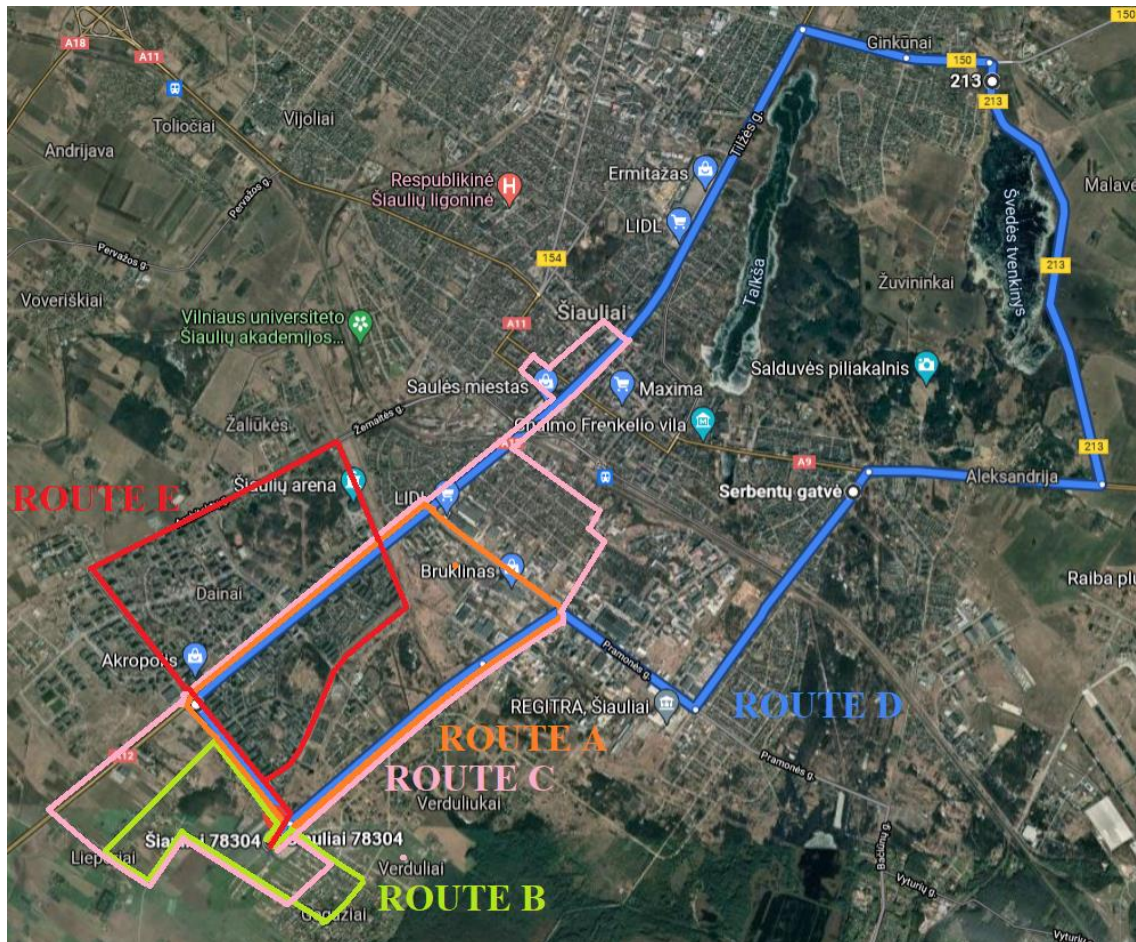
Fig.5. Map of routes A-E

89.49% (57.9 km) of the entire route was paved with asphalt concrete and 10.51% (6.8 km) was a gravel roads. There were 139 possible stops on routes A-E, so there are about 2 possible stops per kilometer driven. All possible stops on the route are shown in Figure 6.
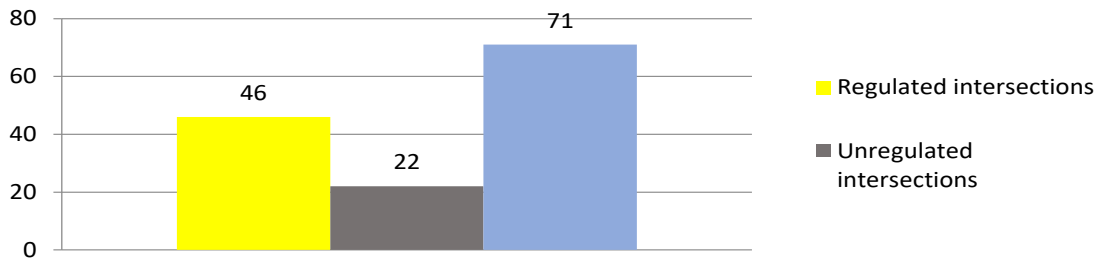
Fig.6. Possible stopping places on routes A-E

As can be seen from the Figure 6 most of the potential stops in this research could be expected at pedestrian crossings. In second place - regulated intersections and in third place - unregulated intersections. It should be mentioned that these are predictable stopping places. There are also stops on the route that are impossible to predict. The more often you need to stop or brake and start moving again the higher fuel consumption will be.

Main focus in this research is to see how driving style can change the fuel consumption while driving. Main differences of driving routes A-E conventionally and in eco-driving style in this research are given in Table 3.

Table 3

Differences of driving conventionally and in eco-driving style

Eco-driving	Conventional driving
Car was driven at around 2000rpm. For example: driving with this car in fourth gear at 50km/h is about 2000rpm.	Car was driven at around 2500-3000rpm mark. For example: driving with this car in third gear at 50km/h is about 2500rpm.
Trying to stop the car without the brake pedal.	Stopping the car with the brake pedal.
Trying to monitor the environment and attempt to maintain constant speed while driving.	Not monitoring the environment and not maintaining constant speed.
All the electrical devices are off (unless the windows fog up).	Electrical devices like car radio, air conditioner, rear window heater were turned on the whole time.
All windows were closed.	All the windows were opened about 50 percent to increase air resistance.
No cargo.	Additional cargo weighing about 30kg is carried in the trunk.

All the results of differences in conventional and eco-driving styles get in this research will be because of these differences written in Table 3.

5. Fuel consumption results of routes A-E

To measure fuel consumption, scales were purchased that could withstand a certain weight and measure to the nearest thousandth of a kilogram, that is, to the nearest 1 gram. Scales that can weigh up to 20 kilograms have also been selected, as the new fuel tank holds 12 liters of liquid and the weight of the fuel pump, fasteners, fuel and ventilation hoses and the new fuel tank must also be added. The study was conducted in October-November 2020, when the average outdoor temperature was 5°C. At this temperature a 1 liter bottle filled with petrol weighs 0.743 kilograms. This figure will be used as a factor in converting the test results from kilograms to liters. Fuel consumption in conventional driving and eco-driving routes in liters is shown in Figure 7.
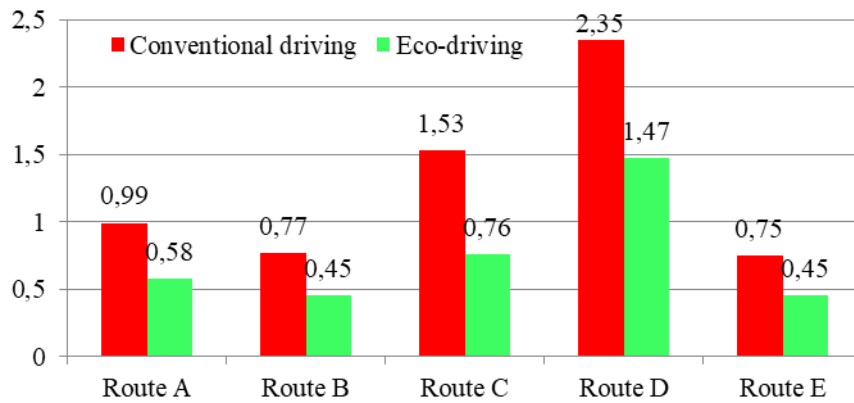
Fig.7. Fuel consumption in liters for conventional driving and eco-driving routes

Figure 7 shows that on all routes A to E, fuel consumption was reduced if eco-driving principles were applied. Fuel consumption in liters per 100 kilometers was calculated and is shown in Figure 8.
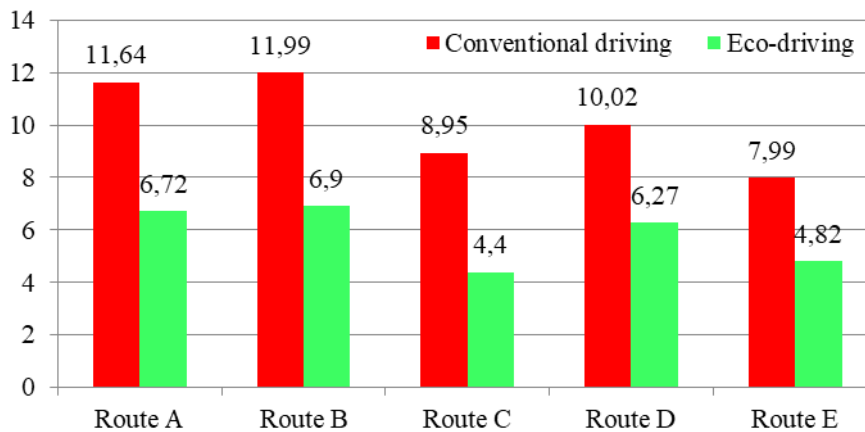
Fig.8. Fuel consumption of conventional driving and eco-driving routes in liters per 100 kilometers

During the study, the highest consumption per 100 kilometers was 11.99 liters and the lowest 4.4 liters. Eco-driving fuel consumption has never exceeded conventional driving fuel consumption.

The smallest difference between normal and eco-driving costs for a distance of 100 kilometers is obtained on route D. Fuel consumption of route D is 10.02 and 6.27 liters with a difference of 37.49%. Even the smallest savings would save more than a third on fuel costs.

The largest difference between conventional and eco-driving consumption for a distance of 100 kilometers is obtained on route C. Fuel consumption of route C is 8.95 and 4.4 liters and the difference is 50.89%, which is more than half.

This shows how a car's fuel consumption can vary and how it changes not just because of characteristics of the route but also because of the driver's driving style. The averages of the results of the study of routes A – E are presented in Table 4.

Table 4

Comparison of conventional and eco-driving fuel consumption of routes A-E

Routes A–E	Conventional driving, l	Eco-driving, l	Difference, l	Difference, %
Fuel consumption of routes A–E	6,37	3,67	2,7	42,39
Average fuel consumption per 100 kilometers	10,11	5,81	4,3	

The application of eco-driving principles on routes A – E has reduced fuel consumption by 2.7 liters or 42.39%. Average fuel consumption per hundred kilometers decreased by 4.3 liters or 42.39%.

6. Ecological benefits of eco-driving

Eco-driving helps to save fuel and protect the environment by emitting fewer pollutants into the air. This research found that the application of eco-driving principles reduced fuel consumption by 42.39%. Using the order of the Ministry of Environment of the Republic of Lithuania: "Methodology for the assessment of pollutants emitted into the atmosphere from machines with internal combustion engines" [3], it is possible to calculate how much pollutants were emitted into the air during the study. A comparison of emissions from normal driving and eco-driving is given in Table 5.

Table 5

Comparison of conventional and eco-driving pollutant emissions of routes A-E

Type of pollutant	Conventional driving pollutants, kg	Eco-driving pollutants, kg	Difference, kg
Carbon monoxide (CO)	2,96	1,708	1,252
Hydrocarbons (CH)	0,613	0,354	0,259
Nitrogen oxides (NOX)	0,126	0,073	0,053
Sulfur dioxide (SO2)	0,009	0,005	0,004

Table 5 shows that eco-driving has reduced emissions of all pollutants. Calculations shows that by using eco-driving rules everyone can contribute to the reduction of air pollution.

7. Financial benefits of eco-driving

Table 4 shows that the fuel consumption of eco-driving routes is about 2.7 liters lower than in conventional driving. The price of A98 petrol on October 16, 2020 when the fuel was purchased was €1,03 per liter. The application of eco-driving principles is estimated to save €4,32 per hundred kilometers.

Lrt.lt conducted a survey on how many kilometers Lithuanians travel per year. The respondents of the survey mostly chose the answer variant, which marked 10–20 thousand annual mileage. This answer was chosen by 39 percent of drivers who answered questions in this survey [2].

If average Lithuanian travels about 15 thousand kilometers per year with a car, it is estimated that using the principles of eco-driving can save €648 per year. That amount of money would be saved just by changing driving habits and starting to use eco-driving rules.

Conclusions

● An additional fuel tank system has been developed to measure the exact amount of fuel consumed and to accurately calculate the difference in fuel consumption.

● Eco-driving routes A-E had lower fuel consumption than conventional driving. After all five routes the average consumption per hundred kilometers was reduced by about 4.3 liters or 42.39%.

● Calculations show that eco-driving has reduced emissions of carbon monoxide (CO), hydrocarbons (CH), nitrogen oxides (NOX) and sulfur dioxide (SO2).

● If average Lithuanian would travel about 15 thousand kilometers per year with this car, it is estimated that using the principles of eco-driving would save about €648.

References

1. Ekovairavimas, kas tai? Retrieved from: https://ecodriving.lt/ekovairavimas/.

2. Kokia Lietuvoje važinėjančių automobilių metinė rida? Retrieved from: https://www.lrt.lt/naujienos/eismas/7/212899/kokia-lietuvoje-vazinejanciu-automobiliu-metine-rida.

3. Lietuvos Respublikos Aplinkos ministerijos įsakymas Dėl teršiančių medžiagų, išmetamų į atmosferą iš mašinų su vidaus degimo varikliais, vertinimo metodikos patvirtinimo. Vilnius, 1998. Retrieved from: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.60273/CbltngxLOi.

4. Peugeot 206 1.1 XR – XT specs. Retrieved from: https://www.ultimatespecs.com/car-specs/Peugeot/2105/Peugeot-206-11-XR---XT.html.

5. J. Barkenbus (2010). Eco-driving: An overlooked climate change initiative.

6. V. C. Magana and M. Munoz-Organero (2015). Gafu: Using a gamification tool to save fuel.

INFLUENCE OF MILITARY INSTRUCTOR'S PRACTICAL EXPERIENCE FOR THE QUALITY OF TEACHING IN VILNIUS UNIVERSITY OF APPLIED SCIENCES

Nerijus Černius
Vilnius University of Applied Sciences
Lithuania

Annotation

The article presents a military instructor's experience in teaching soldiers and the transfer of this experience to the students. Applying various teaching methods in practice it makes easier for both teachers and students to adapt to the new challenges in throughout the study process. Also students' opinion and assessment of the quality of teaching presents an important segment of the evaluation of this process. The author examined students from the Faculty of Health Care of Vilnius University of Applied Sciences learning outcomes, their opinion on the pedagogical benefits of the subject / module being studied as well as conducted a self-assessment of teaching process. The learning outcomes of 311 students were assessed and 41 student provided feedback on this teaching process. The article reveals various methods of teaching. Ways to improve students' motivation are assessed, as well as social relations and development of students' skills necessary for the subject / module being studied. The research results revealed that students appreciate the course and procedures of organizing and conducting lectures of a teacher with experience as a military instructor and applying various forms and methods in this teaching process.

Keywords: students, teacher, lecture, teaching process, subject / module.

Introduction

After the acceptance of Bologna Declaration (1999), which was directed to encourage European cooperation in quality assurance of higher education with a view to developing comparable criteria and methodologies, more attention was given to the student-centered paradigm. Quality assurance has been a priority for the Bologna Process, but its mechanisms are not perceived as an end in themselves. It is important to note that in the student-centered paradigm the traditional role of the teacher has also changed. Although teacher-centered paradigm is not so relevant, but it is important to keep in mind that the role of the teacher is the essential in the teaching process.

Therefore, in this context, it is important to state, that with the increasing progress of science, the transition to innovative forms and teaching methods, and the introduction of distance learning in all study process, there arises a need to have competent teachers. It states that with the development of existing or new forms and teaching methods, the demand of students for the quality of teaching is also increasing. Teachers need to make the most of the time devoted to lectures and pass their theoretical knowledge and practical skills to the students. All this presupposes the requirements for improving the quality of the taught subject / module. The traditional organization and performance of the teaching process, as it is in the military, limits the instructor's and / or teacher's creativity and teaching mastery. It should be noted, that no matter how conservative experience of military teaching process is, but it is also useful in improving teaching quality in a civilian institution.

The article reveals the main factors influencing the quality of students teaching, taking into account the experience of a military instructor in organizing and conducting the military teaching process. It is important to note, that in the military other provisions and principles are followed in the training of soldiers, compared to those applied at the university. For this reason, various forms and teaching methods are discussed, also students' attitudes and needs on further improving the quality of their teaching. Empirical data present to assess the qualitative aspects of teaching progress.

Research problem. After analyzing the research conducted in Lithuania and abroad, it can be concluded that the individual role of the teacher, especially his inter-institutional experience and competence, which would help him to improve the quality of teaching process, is not given much attention. The most significant number of Lithuanian and foreign researchers, such as Dranevičienė (2006), Gudžinskienė (2007), Baršauskienė et al. (2010), Peilakauskaitė et al. (2011), Harden et al. (2013), Gill (2008), Lemos et al. (2014), Sedej (2016), Marinko (2016) and other authors focus on the study process and its compliance with quality

requirements, students' teaching methods, their cooperation with teacher, also learning environment and etc. Studies conducted by various authors provides many strategies and tips on how to improve the quality of teaching, but this is not always enough to organize and conduct students teaching in practice. One of the most significant works in analyzing the influence of military instructors' experience with students is a study conducted by Migdalski (2019). It is essential to understand not only the theoretical aspects of education but also to have good practical skills how to organize and conduct the teaching process. For this reason, it is expedient to conduct research and analyze the dynamic changes taking place in the study process, which would help to improve the quality of the teaching.

Research object: the students' teaching process at the Vilnius University of Applied Sciences based on a military instructor's practical experience.

Objectives of the research:
1. To reveal the theoretical aspects of the teaching process of soldiers and students.
2. To explain the order and course of lectures.
3. To explain the need of independent assignments for students.
4. To describe the system of students' knowledge assessment and testing.
5. To examine students' opinion about the organization and implementation of the law subject / module teaching process, their wishes, and suggestions on how to improve this process.

Research methods:
1. Analysis of scientific literature.
2. Statistical method.
3. Monitoring.
4. Data analysis.

Literature review
The teaching process for soldiers and students has some similarities and differences. First of all, it is essential to understand that the military is an organization in which the relationship between soldiers are based on strict subordination. The teaching process of soldiers is strictly structured, in which the military instructor does not have the freedom of expression. Secondly, the special training of military instructors, teamwork, cooperation with international partners, as well as other aspects contribute to the process of improving the quality of teaching process. Both the military instructor and the teacher have to work hard to acquire the knowledge and personal attributes that support the idea of teaching. In order for the whole teaching process to run smoothly, a number of ideas need to be used. It should be noted that training (teaching) is a top priority for the military. This training is an organized collaboration designed to achieve set goals between an instructor and a soldier, and the instructor is the leader of that collaboration. The Lithuanian Armed Forces has taken over the examples of the Danish Armed Forces on how to plan, prepare and conduct trainings. It is important to explain to soldiers the purpose of the training, which is why the training is being conducted, and it is important for the instructor to engage the soldiers and explain what they will learn, what they will have to pay (know, explain, indicate, etc.) at the end of the training. The objectives of knowledge training are described in terms of requirements, circumstances and criteria. The structure of military training is as follows:

1. During the introductory part, it is first checked whether the soldiers are ready for the training process (writing instruments, notes, necessary legal acts, etc.). The aim is then to test the soldiers' theoretical knowledge from the previous topic, for which the soldiers have to answer the control questions. The introductory part introduces new topic, indicates the purpose of training, the course of topic (how many teaching issues will be analyzed, the method, how much time will be spent on topic and how the assessment of soldiers will be carried out). The following is the order of the lecture (opportunity to ask questions, answer questions, and take noted) is presented below. The introductory part presents the motivation and the basics of the overall assessment.

2. Lecture part (presentation of theoretical material).

3. The control phase is carried out at the end of each topic and control questions are asked (indicating the soldiers who will answer the given question). At the end of training there is a final knowledge test, during which the majority of soldiers must be interviewed.

4. During the generalization phase, the training is summarized, the most important issues are emphasized and the soldiers are evaluated. After that it is indicated what the next training will take place, what the soldiers will have to do during the preparation and etc. It should be noted that the variety of teaching methods has the most significant impact on the motivation of soldiers. A military instructor must use a variety of techniques such as lecture, conversation, exercise, competition, assignment, case study, and extramural. When assessing the diversity of

choice of different teaching methods, it is necessary to pay attention to the advantages and disadvantages of the lecture. The advantage of this method is the rapid transfer of knowledge to a large number of soldiers at once, taking into account those who have difficulty reading and the language corresponds to their level. The main disadvantage of this method is that a long lecture deduces the percentage of its memorization, and poor lecture structure and a dormant lecture is a waste of time. When organizing military training, the military instructor must have an exercise plan and follow the consistency of conducting the exercise. At the same time, a military instructor must be characterized by responsibility, creativity, flexibility, patience and positivity [7, 13].

It should be noted that Lithuanian Armed Forces has installed a distance learning module, abbreviated as ADL (Advanced Distributed Learning). Distance learning is a form of each teaching where the learner does not maintain a constant connection with the instructor. Such training can be provided 24 hours a day, 7 days a week (24/7). This training system provides different military courses with a variety of information sources, including videos. After reviewing videos or other information sources, it is necessary to answer the final control (test) questions). Distance learning is often combined with traditional training methods, thus saving time on the training process. It is not difficult to use such a distance learning system, but it requires special training to administer it and develop a training module. Thus, all of things related to the process of training soldiers can be partially adapted to the organization and conduct of students teaching.

It should be noted that in the Common European Principles for Teacher Competence and Qualification provided by European Commission, stated that teachers play a crucial role in supporting the learning experience of young people and adult learners. They are key players in how education systems evolve and in the implementation of the reforms which can make the European Union the highest performing knowledge-driven economy in the world. The role of teachers and their lifelong learning, same as career development is a key priority. Although teachers play a critical role in society, they cannot act alone. Their own high quality education needs to be supported by the institutions where they are employed. There are four common European principles that should provide an impetus for developing policies which will enhance the quality and efficiency of education. The common European principles are:

1. **A well-qualified profession**: high quality education system require that all teachers are graduates from education institutions. Each teacher should have the opportunity to continue studies to the highest level in order to develop their teaching competence, and to increase their opportunities for progression within profession.

2. **A profession placed within the context of lifelong learning**: teachers should be supported in order to continue their professional development throughout their careers. Teachers should be encouraged to review evidence of effective practice and engage with current innovation and research in order to keep pace with the evolving knowledge society.

3. **A mobile profession:** mobility should be a central component of initial and continuing teacher education programs. There should also the opportunity for mobility between different levels of education and towards different professions within the education sector.

4. **A profession based partnerships:** Teacher education partnerships, which have an emphasis on practical skills and an academic and scientific basis, should provide teachers with the competence and confidence to reflect on their own and others' practice. Teacher education, in itself, should be supported and be an object of study and research [2].

As it was noted before, the main focus today is on student-centered paradigm. Gill (2008) notes that "student-centered learning is not a technique but an attitude" [5]. Each teacher uses specific teaching methods. The quality of teaching depends on various factors, including the teacher-student relationship, systematic counseling, integrated tasks, active teaching methods, students' attitudes to the subject, their motivation, feedback, subject content, teacher's appropriate choice of teaching methods and etc. Petrauskaitė and Varanauskas (2011) noted that students need methodological help and support when learning, because, among other things, their learning style differs. Some students find it easier to absorb the information provided in writing, some with the help of visual aids, while others need audio or sensory material. It is essential to engage the results achieved during teaching contribute to the improvement of the quality of students [14]. Meanwhile, Baršauskienė et al. (2010) state that the exchange of information, experiences, decisions, and feelings provides an opportunity to influence (argue, motivate, ask, tell) [1].

The pedagogical paradigm can be implemented in a variety of ways. The main source of students' knowledge is a lecture in which the teacher conveys scientific theoretical information and students passively accept the ideas and thoughts of one speaker, memorizing them to pass the colloquium and exam. It develops students' memory, but not creative thinking. Gudžinskienė (2007) stated that a lecture is a specific method by which a teacher simultaneously orally

conveys information in a particular field. Although listeners are usually silent, this does not mean that they are not active [6]. The lecture and its effectiveness depend on the competence of the teacher. The effectiveness of the lecture is stimulated by the use of various examples; the teacher periodically asks students questions to activate their participation in the lecture and check whether students understand the content of the lecture.

Course and order of lectures

In the analyzed case, when teaching the legal subject / module to the Faculty of Health Care of Vilnius University of Applied Sciences, its course and procedure are presented in introductory lectures. The subject / module is presented during the first lecture, indicating how many hours and credits are allocated to it and how and when the classes will take place. Students are introduced to the aim and intended results of the subject / module. Students are explained what they will be able to do when they complete this subject / module. Students are then introduced to the individual parts of the subject / module, what they make up and how much time will be devoted to it. Presentations are presented, the order and course of lectures are indicated. The teacher explains how to register in the *Moodle* environment where the subject / module can be found. Contact details of the teacher are provided. The teacher's personalized approach to students is followed, as students can contact the teacher by phone, write him an email ant etc. Letters during working and non-working hours, as only this way, can the teacher assist students who do not know how to complete an independent assignment and prepare for a lecture or assessment.

Future teaching process is organized and conducted remotely using *Teams* communication platform, *Moodle* environment, *Outlook Stream* and *Forms* components. It should be noted that distance learning facilitates the use of modern technologies, saves students' and teacher's time, facilitates mutual communication, which is usually hampered by distance. Distance learning is a new 21st century educational space and it is necessary to strive for it to be of high quality, not inferior to traditional teaching. The law subject / module consists of the basics of law and heath law. 8 or 10 academic hours are devoted to the presentation of the basics of law. Theoretical material from the basics of legal theory, constitutional law, civil law, and labor law is presented in the *Teams* environment using the *PowerPoint* presentation (slides) computer program. The presentation of heath law takes from 16 to 34 academic hours, depending on the different study programs. In this case, the primary laws of health law and by-laws are presented.

The duration of one lecture is 1 hour and 30 minutes (2 academic hours), of which 1 hour is devoted to the theoretical part of the lecture, leaving time for discussion with students, as well as questions of intermediate control of the knowledge during the lectures, and at the end of lectures 10 or 15 minutes' time is devoted to the final control of the knowledge (self-control test), indicating how many questions will be in the test and the criteria for a positive assessment. A clear system for providing feedback on the teaching process is needed. Harden and Laidlaw (2013) emphasized that teacher should provide feedback, individualize teaching and learning, and make it appropriate [5]. In this case, it is necessary to explain to the students what the benefits of the subject / module are. Feedback is obtained through intermediate and final control. The primary purpose of the intermediate and final control is to encourage students to listen and participate in the lecture actively. Sedej (2016) noted that the teacher must explain the process of answering the questions and make suggestions on how to respond to the questions: 1) thank you for the question (I am glad you noticed this; you asked a very important question; of course there are different opinions that contradict each other) or 2) ask yourself a question (what made you ask this? Could you specify the question? What exactly would you like to know? [16].

Methodology

The monitoring method collected information about student's behavior during lectures and recorded all the values of the variables of interest. All groups of students were selected for monitoring, observing not only the behavior of individual student, but also the behavior of the whole group of students during the lectures (under natural conditions). Unstructured observation helped to collect primary data on the quality of teaching.

The method of data analysis also was used in this research. Research involved students from the Faculty of Health Care of Vilnius University of Applied Sciences with different study programs, such as Physiotherapy, Dietetics, Hygienic Cosmetology, Radiology, Biomedical Diagnostics, Occupational Therapy and General Practice Nursing.

An assessment of the learning outcomes of **311** students (**N**) was performed. At this point, the evaluation criterion was the scores that the students received during the colloquiums and exams. The available data of the study subject / module evaluation summary (journals)

allowed to evaluate colloquium and exam results during the autumn and spring semesters of 2020 / 2021. No questionnaires were provided to students at this stage of research.

The results of the study were also subjectively evaluated by the subjects by completing a questionnaire in which they provided an assessment of each statement made about the teaching process. The questionnaire survey of full-time students (qualitative research) was conducted by the administration of the Faculty of Health Care of Vilnius University of Applied Sciences. It helped to assess in detail the quality of the taught subject / module. Students had to assess the extent to which they agree or disagree with the statements made about the quality of teaching of the studied subject / module. There were eleven of these statements. These statements are:

1. Assessment forms and criteria were specified at the beginning of the teaching.
2. Evaluation followed the published evaluation forms and criteria.
3. Content was clear.
4. Theory was illustrated by practical examples.
5. Students were encouraged to formulate problematic questions, analyze, discuss, and etc.
6. Lecture time was used rationally.
7. Communication with students was respectful.
8. Assessment results were discussed (in writing or orally).
9. If necessary, the teacher was consulted outside the lectures.
10. The use of additional sources of information were encouraged.
11. Academic dishonesty was intolerable (plagiarism and etc.).

Students had to choose one of six options for answering the statement when assessing the quality of teaching. These opinions are: strongly agree; agree; neither agree, nor disagree; disagree; totally disagree and don't know / Can't say. **76** students (**N**) of the Faculty of Health Care of Vilnius University of Applied Sciences participated in this research.

Research results

Dranevičienė (2006) states that the process of education is based on the method of monitoring. The teacher monitors and evaluates the student and the student monitors and evaluates the teacher [3]. Observation provides immediate information that aims to reveal and understand the social environment through actions and events from the perspective of both participants and the observer. Thus, during the final control, self-control tests are provided in the *Teams* environment (link to *Outlook Forms*). Self-control tests questions are closed. If the answer to the question is chosen it is indicated whether the correct answer to the question has been chosen or not and what it should have been. This facilitates feedback. After the self-control test, its results are discussed, whether the students have mastered the information provided during the lecture is ascertained. Later a short overview of the lecture is provided and assignments to the students are given. Students in the *Moodle* environment can find lecture slides and other learning materials. The students survey found that they were in favor of self-control tests. In this case, some of them noted that "beneficial self-control tests", others that "very much liked tests" and that the teacher gave them these tests in the lecture on the newly taught material. For this reason, self-control tests are "clever application to memorize knowledge", "makes students listen carefully" as well as "made it easier to pass the colloquium and the exam".

It has also been observed that it is difficult to maintain the equal interest of students in the subject being taught during lectures. For this reason, there is a need to change teaching methods. Although efforts are made to involve students in discussion, most of them are passive and do not like to discuss, and no more than 6-8 students from each group are asking questions or (and) answering questions during the lectures.

In most cases, students who actively participated in the lectures indicated at the end of the lecture that the teacher "involved in the discussion of the subject / module", "the teacher managed to motivate students and start a discussion", "forced active participation in the lecture", "involved students in the lecture by asking intermediate questions", encouraged communication, active participation in the lecture and notices everyone who speaks" and "it was interesting to listen and to discuss". It was also the case that during the intermediate knowledge control, when the teacher asked the students a question, no answer was received, o the final knowledge control results were unsatisfactory. At the end of the semester, a student comment was received, that "it is difficult to get an interim report after each lecture because it is hard to remember and answer the questions after new topic". As a result, personal attitudes and teaching styles were changed during the teaching process, and self-assessment was performed.

It should be noted that the attention of students, like soldiers, is most significant at the beginning of the lecture, later it falls and rises again only at the end of lecture. Students become more tired during the lectures when laws are analyzed. For this reason, they are given an independent assignment to answer the questions and review new laws independently. Independent tasks given to students are an active method of organizing the teaching process. During the independent tasks, students have to look for answers by studding the literature sources indicated in the study subject program, thus developing their information literacy competencies and abilities. Independent assignments received favorably evaluation from students, such as "self-directed assignments clearly formulated" or "the teacher assigning various independent assignments that helped prepare for the final settlements". It was explained to the students that is not necessary to memorize the subject being taught, although such a students' comment was received that "the teacher wanted the students to memorize the Constitution". It was observed that students with better scores are more diligent listeners of lectures and performers of independent assignments. It has also been noticed that some students with lower educational attainment are lazy to study, for others the subject / module is simply not exciting and insignificant. These students provided the following comments such as "general and inappropriate information provided", "in my professional activities it will not be necessary, therefore it is not expedient to study all this" or "I think that too much time is devoted to the legal part, it makes more sense to use that time for other lectures related to specialty". Whatever the assessments or comments, each teacher must also understand that tasks, legislation, syllabi, self-assessment tests, or self-study questions in students' best interests must be constantly reviewed and updated during the teaching process.

It should be noted that the teacher must show that he / she values and respects students, therefore he / she must be polite, able to motivate students, explain why is worth studying this subject / module so that he / she can apply the general legal knowledge not only in work but also in personal life. Marinko (2016) notes that "the teacher must be friendly and patient with the students, but should clearly identify the student's mistakes. It is necessary to point out the strengths and weakness, not just mistakes" [10]. Formal communication with students is not an expression of respect. It needs to be understood that teachers and students are part of the same organization. Often students asked not only for study-related assistance, but also for assistance with personal matters where the teacher needed legal or other advice, such as pet housing conditions, custody and care issues, working atmosphere (insults) in health care facility, disputes and their solutions to the quality of purchased clothes, the son's service in Lithuanian Armed Forces and etc. Addressing such issues creates a better atmosphere between teachers and students. Comments were received from students such as "pleasantly communicating teacher", "teacher is very benevolent", "it was possible to ask off-topic questions ant the teacher always answered them" or "always answered questions and consulted". Students are also contacted by email. Communication via email is one way to help students. Today email is a prevalent thing, and teachers use it. Still, when writing letters to students or answering their questions, the essential part of the letter is its content. The teacher must avoid negative emotions that would affect negative communication between teacher and student.

At the end of lecturer, students' knowledge must be tested and assessed. Pečkaitis (2001) noted that "testing and assessment of students' knowledge is one of the most important components of the study process" [12]. Meanwhile, Lemos et al. (2014) noted the importance of student responsibility for learning outcomes [8]. A colloquium is written upon completing the legal basics part and the health law part – an exam. Before this, students are given systematized indicative questions for the colloquium and exam, indicating how the assessments will take place. Marinko (2016) notes that "students should know the duration of the exam, how many questions, where there are questions with multiple choice, what grade they will receive for a certain number of correct answers" [9]. Before the assessment, students are introduced to the assessment process and procedure (time, number of questions and etc.), subgroups are presented, students are asked to check or see the assessment test and the teacher notes that he / she will be available during the assessment, ask questions or apply in case of problems. Assessments are done in the *Moodle* environment, which provides a test of 40 open-ended and closed-ended questions. The test takes 45 minutes. Some questions are more accessible, others more complex. The focus is on academic integrity. Before the assessment, all theoretical material in the *Moodle* environment is closed to be inaccessible to students. Students themselves are divided into three subgroups with different questions. The questions in the tests are shuffled, that is, they are not listed in order.

Students' learning process was further scored. The results of the colloquium were as follows: 10 (excellent) score were given to 53, 9 (very good) – 109, 8 (good) – 83, 7 (average) – 42, 6 (satisfactory) – 18, 5 (weak) – 5 and 4 (unsatisfactory) – 1 student. The results of the exam were as follows: 10 (excellent) were received by 111, 9 (very good) – 139, 8 (good) – 46,

7 (average) – 15 students. It should be noted that no student received a score of 6 (satisfactory) and lower from the exam. It must be said that good students are not those who have good scores, but those whose knowledge is good. The results of the final assessments are presented in Table 1.

Table 1

Results of the final assessments

Score	Colloquium		Exam	
	N	%	N	%
10 (excellent)	53	17	111	35,6
9 (very good)	109	35	139	44,7
8 (good)	83	26,5	46	14,8
7 (average)	42	13,5	15	4,9
6 (satisfactory)	18	5,7	0	0
5 (weak)	5	1,6	0	0
4 (unsatisfactory)	1	0,7	0	0

Based on the data presented in Table 1, it is observed that more than half (52%) students passed the colloquium perfectly or very well and well or on average 40% students who took this final assessment. 7,3% students passed colloquium satisfactory or weakly. Meanwhile, more than two-thirds (80%) passed the exam excellently or very well and well or on average 19,7% students who took this exam. No student who passed the exam was assessed as satisfactory or weak. Based on the research data, it can be conducted that the whole teaching process was of high quality and during it the students received the necessary theoretical knowledge, which was demonstrated during the final examinations. It was observed that the evaluation result of the exam is better in comparison with evaluation result of the colloquium. This difference can be explained by the fact that for the theoretical material of the exam was devoted from two to three times more time comparing with colloquium. Students completed many independent assignments in preparation for takin the exam. No independent assignments were prepared during the lectures about legal basics.

A questionnaire survey of students was conducted, which allowed to assess the quality of teaching. **76** respondents (**N**) participated in this research. The following is an assessment of each statement.

1. Assessment forms and criteria

Respondents were asked to rate assessment forms and criteria, which had to be specified at the beginning of teaching process. Individual statements about the assessment forms and criteria are presented in Table 2.

Table 2

Assessment forms and criteria

Answer	N	%
Statement: assessment forms and criteria were specified at the beginning of the teaching		
Strongly agree	66	86,9
Agree	9	11,8
Neither agree, nor disagree	1	1,3
Disagree	0	0
Totally disagree	0	0
Don't know / Can't say	0	0

The results of research showed that 98,7 % of respondents rated mentioned statement "strongly agree" or "agree". This shows that assessment forms and criteria were specified at the beginning of the teaching.

2. Compliance with the evaluation procedures

Respondents were asked to rate teacher's compliance with defined evaluation procedures. Individual statements about the compliance with published evaluation forms and criteria are presented in Table 3.

Table 3

Compliance with the evaluation procedures

Answer	N	%
Statement: evaluation followed the published evaluation forms and criteria		
Strongly agree	68	89,5
Agree	8	10,5
Neither agree, nor disagree	0	0
Disagree	0	0
Totally disagree	0	0
Don't know / Can't say	0	0

The results of research showed that 100 % of respondents rated this statement "strongly agree" or "agree". This shows that teacher followed the published evaluation forms and criteria.

3. Clarity of teaching content
Respondents were asked to evaluate whether the teaching content was clear or not. Individual statements about the clarity of teaching content are presented in Table 4.

Table 4

Clarity of teaching content

Answer	N	%
Statement: content was clear		
Totally agree	62	80,3
Agree	11	14,5
Neither agree, nor disagree	2	2,6
Disagree	0	0
Totally disagree	1	1,3
Don't know / Can't say	0	0

The results of research showed that 94,8 % of respondents rated this statement "strongly agree" or "agree". It should be noted that a small group of respondents (3,9 %) pointed out that clarity of teaching content was not so clear, or they don't know if teaching content was clear.

4. Theory and practical examples
Respondents were asked to evaluate if theory of the studied subject was illustrated by practical examples. Individual statements if theory was illustrated by practical examples are presented in Table 5.

Table 5

Theory and practical examples

Answer	N	%
Statement: theory was illustrated by practical examples		
Totally agree	56	75,1
Agree	13	17,1
Neither agree, nor disagree	5	6,5
Disagree	1	1,3
Totally disagree	0	0
Don't know / Can't say	0	0

The results of research showed that 92,2 % of respondents are thinking, that theory of studied subject was illustrated by practical examples. 6,5 % of respondents neither agree, nor disagree with the statement if theory, which was presented during the lectures was illustrated by practical examples.

5. Formulation of problematic questions, analyze and discussion

Respondents were asked to rate the statement, that they were encouraged to formulate problematic questions, analyze and discuss. Opinion of respondents on the given statement is presented in Table 6.

Table 6

Formulation of problematic questions, analyze and discussion

Answer	N	%
Statement: students were encouraged to formulate problematic questions, analyze, discuss, and etc.		
Strongly agree	57	75,1
Agree	12	15,8
Neither agree, nor disagree	6	7,8
Disagree	1	1,3
Strongly disagree	0	0
Don't know / Can't say	0	0

The results of research showed that 90,9 % of respondents agrees with the statement that students were encouraged to formulate problematic questions, analyze, discuss, and etc. It is important to note that 7,8 % of respondents neither agree, nor disagree with the statement it the students were encouraged to formulate problematic questions, analyze, discuss, and etc.

6. Lecture time

Respondents were asked to evaluate whether lecture time was used rationally or not. Opinion of respondents on the given statement is presented in Table 7.

Table 7

Lecture time

Answer	N	%
Statement: lecture time was used rationally		
Strongly agree	59	77,7
Agree	13	17,1
Neither agree, nor disagree	0	0
Disagree	4	5,2
Strongly disagree	0	0
Don't know / Can't say	0	0

The results of research showed that 94,8 % of respondents agrees with the statement that lecture time was used rationally. A small group of respondents (5,2 %) indicated that lecture time was not used rationally. No further comments were received as to why this lecture time was used irrationally.

7. Communication with students

Respondents were asked to evaluate if communication with students was respectful. Individual statements about the communication with students are presented in Table 8.

Table 8

Communication with students

Answer	N	%
Statement: communication with students was respectful		
Strongly agree	71	93,5
Agree	5	6,5
Neither agree, nor disagree	0	0
Disagree	0	0
Strongly disagree	0	0
Don't know / Can't say	0	0

The results of research showed that all respondents are thinking that communication with students during the teaching process was respectful.

8. Feedback about assessment results

Respondents were asked to rate the statement, that assessment results were discussed (in writing or orally). Opinion of respondents on the given statement is presented in Table 9.

Table 9

Feedback about assessment results

Answer	N	%
Statement: assessment results were discussed (in writing or orally)		
Strongly agree	57	73,8
Agree	14	18,4
Neither agree, nor disagree	1	1,3
Disagree	0	0
Strongly disagree	1	1,3
Don't know / Can't say	4	5,2

The results of research showed that 92,2 % of respondents agrees with the statement that assessment results were discussed. 5,2 % of respondents answers considerable shows, that these respondents did not attended lectures, during which assessment results were discussed.

9. Consultations outside the lectures

Respondents were asked to evaluate whether the teacher consulted them outside the lectures if necessary, or not. Individual statements if the teacher consulted students outside the lectures if necessary are presented in Table 10.

Table 10

Consultations outside the lectures

Answer	N	%
Statement: if necessary, the teacher was consulted outside the lectures		
Strongly Agree	52	68,5
Agree	4	5,2
Neither agree nor disagree	2	2,6
Disagree	0	0
Disagree	0	0
Don't know / Can't say	18	23,7

The results of research showed that 72,7 % of respondents agrees with the statement that, if necessary, the teacher was consulted outside the lectures. 26,3 % of respondents neither agree nor disagree or don't know / can't say that the teacher consulted them outside the lectures if necessary. Such responses of respondents to the statement can be explained by the fact that these respondents may not have needed consultations or were unaware of the possibility of such consultations.

10. The use of additional sources of information

Respondents were asked to rate the statement, that the use of additional sources of information was encouraged. Opinion of respondents on the given statement is presented in Table 11.

Table 11

The use of additional sources of information

Answer	N	%
Statement: the use of additional sources of information were encouraged		
Agree	50	65,9
Agree	17	22,4

Neither agree nor disagree	3	3,9
Disagree	0	0
Disagree	0	0
Don't know / Can't say	6	7,8

The results of research showed that 88,3 % of respondents agrees with the statement. It is important to note, that 7,8 % of respondents don't know or can't say if the use pf additional sources of information were encouraged. Such an assessment of the respondents creates a need for future emphasis on the possibility for students to learn from additional sources of information.

11. Prevention of academic dishonesty
Respondents were asked to evaluate if academic dishonesty was intolerable or not. Opinion of respondents on the given statement is presented in Table 12.

Table 12

Prevention of academic dishonesty

Answer	N	%
Statement: academic dishonesty was intolerable (plagiarism and etc.)		
Strongly agree	54	71,4
Agree	4	5,2
Neither agree, nor disagree	2	2,6
Disagree	1	1,3
Strongly disagree	0	0
Don't know / Can't say	15	19,5

The results of research showed that 76,6 % of respondents agrees with the statement. 19,5 % of respondents stated that they don't know or can't say if academic dishonesty was intolerable. Such an assessment of the respondents creates a need for future emphasis highlight the fact, that academic dishonesty will be intolerable in all teaching process, including independent assignments, colloquiums, exams and etc.

Conclusions
1. Students teaching has moved from the auditoriums to the other environments, such as an environment adapted to distance learning, which naturally poses certain challenges for both teachers and students themselves. Teachers have a duty to maintain the quality of teaching. In order to improve the quality of teaching, it is necessary to take into account the needs and opportunities of students. It is also important to change the attitude of teachers to teaching methods, because a responsible, understanding, patient, attentive, self-confident, flexible, organized and professional teacher is a great value.
2. Understanding and interpreting teaching, which is nor a static but changing process, depends on the competence of each teacher and such a teaching process should become an instrument of self-realization of each teacher. In this process, personal attitudes and teaching styles need to be changed, and self-assessment has been done.
3. Based on the research data, it is concluded that the majority of students positively evaluate the teaching modules of the law subject / module. It can be stated that students have not yet sufficiently mastered the methodology of self-education, therefore the assigned independent tasks encourage students to improve independently.
4. The study revealed the advantages and disadvantages of organizing the teaching process and raised the main challenges in which direction to improve teaching quality. Those teaching methods that worked in the military did not fully prove their application in Vilnius University of Applied Sciences (e. g., intermediate control, attempt to engage passive students in discussion and etc.), but at the same time the military instructor's experience contributes to innovative teaching methods and more active student participation during lectures.

References
1. Baršauskienė V., Almonaitienė J., Lekavičienė R., Antinienė D. Žmonių santykiai organizacijose. Kaunas: Technologija; 2010.

2. Common European Principles for Teacher Competences and Qualifications. European Commission. Available from: http://www.pef.uni-lj.si/bologna/dokumenti/eu-common-principles.pdf

3. Dranevičienė N. Pedagogo asmenybės svarba besimokančiajam; 2006. Available from: http://www.elibrary.lt/resursai/Konferencijos/Rokiskis_30/konf_30_10.pdf

4. Harden R. M, Laidlaw J. M. Be fair to students: four principles that lead to more effective learning, Medical Teacher, vol. 35, p. 27–31; 2013.

5. Gill J. Social inclusion for South Australian schooling? Trying to reconcile the promise and the practice, Journal of Education Policy, 23 (5), 453-467; 2008.

6. Gudžinskienė V. Modulio „Šiuolaikinės studijų technologijos" mokomoji medžiaga. *Aukštosios mokyklos dėstytojų pedagoginių kompetencijų bei gebėjimo taikyti šiuolaikines studijų technologijas tobulinimas.* Vilnius: Petro ofsetas; 2007.

7. Karių ugdymo pagrindai. Patvirtinta naudoti Lietuvos kariuomenėje kariuomenės vado 2002 m. balandžio 23 d. įsakymu Nr. 351; 2002.

8. Lemos A. R, Sandars J. E, Alves P, Costal M. J. The evaluation of student-centered of teaching and learning: a new mixed-methods approach, International Journal of Medical Education, vol. 5, p. 157–164; 2014.

9. Marinko I. Vertinimas – dėstytojo pastabos apie egzaminą; 2016. Available from: https://www.kaunokolegija.lt/kk_wp_content/uploads/2018/11/100-B%C5%AAD%C5%B2-KAIP-PAGERINTI-DESTYMA_-DESTYTOJO-KNYGA.pdf

10. Marinko I. Personalizuotas požiūris į studentą – paruošti studentus egzaminams; 2016. . Available from: https://www.kaunokolegija.lt/kk_wp_content/uploads/2018/11/100-B%C5%AAD%C5%B2-KAIP-PAGERINTI-DESTYMA_-DESTYTOJO-KNYGA.pdf.

12. Migdalski S. Investigating Military Instructors 'Experience with Students use of Personal Technology: A Phenomenological Study. A doctor 's dissertation; 2019. Available from: https://digitalcommons.liberty.edu/cgi/viewcontent.cgi?article=3289&context=doctoral.

13. Pečkaitis J. Studijų kokybės tobulinimas: studentų požiūris. Jurisprudencija, t. 20 (12) 123–142; 2001.

14. Pratybų planavimas, pasiruošimas ir jų vedimas. Instruktorių kurso Nr. 1 neakivaizdinio mokymo teorinė medžiaga. Krašto apsaugos savanorių pajėgų Lietuvos didžiojo kunigaikščio Butigeidžio dragūnų mokomasis batalionas, Vilnius; 2005.

15. Peilakauskaitė K., Varanauskas A. Studijų programų atnaujinimas : studentų vaidmuo diegiant ir tobulinant kompetencijomis grįstą ir į studentus orientuotą studijų sistemą; 2011. Available from: http://www4066.vu.lt/Files/File/Studiju%20programu%20atnaujinimas_studentu%20vaidmuo.pdf

16. Peilakauskaitė K., Varanauskas A. *Studijų programų atnaujinimas : studentų vaidmuo diegiant ir tobulinant kompetencijomis grįstą ir į studentus orientuotą studijų sistemą; 2011.* Available from: http://www4066.vu.lt/Files/File/Studiju%20programu%20atnaujinimas_studentu%20vaidmuo.pdf

17. Sedej T. Darbų, parengtų seminarų metu pristatymas ir studentų skatinimas aktyviai bendradarbiauti; 2016. Available from:
https://www.kaunokolegija.lt/kk_wp_content/uploads/2018/11/100-B%C5%AAD%C5%B2-KAIP-PAGERINTI-DESTYMA_-DESTYTOJO-KNYGA.pdf

THE ANALYSIS OF INFORMATION SEEKING BEHAVIOUR OF THE TEACHERS OF ŠIAULIAI STATE UNIVERSITY of APPLIED SCIENCES

Gerda Gasparaitytė
Šiauliai State University of Applied Sciences
Lithuania

Rita Jakutienė
Šiauliai State University of Applied Sciences
Lithuania

Annotation
Information is a basic human need. Information is necessary for socio-economic development. Information seeking behaviour is defined as the area related to the identification of user information needs, seeking behaviour, and subsequent use of information. Information seeking occurs when a person realizes the need to acquire contextual information and consciously takes action to meet that need. The research on information behaviour has evolved in various directions and maintained its popularity. Information behaviour research provides a better understanding of how people actually use information in all aspects of life, improving the analysis of information behaviour, processes, and systems in different information spaces. Information behaviour models attempt to describe information seeking activities, the causes and consequences of these activities, or the relationships between the stages of information seeking behaviour. The article presents the research of information seeking behaviour of the teachers of Šiauliai State University of Applied Sciences. In order to study information behaviour of Šiauliai State University of Applied Sciences teachers, an information behaviour model was developed based on T. D. Wilson, Othishi-Gottschalg-Duque information behaviour models, where the main elements are user information needs, information sources, information seeking process and information seeking obstacles. The survey was chosen as the data collection method. A questionnaire with the same content was provided to all the respondents. The questionnaire contained 15 questions aimed at identifying specific facts relevant to the research. 108 questionnaires were sent to the academic staff of Šiauliai State University of Applied Sciences, which they were asked to fill in electronically. 73 questionnaires were submitted.

Key words: information behaviour, information seeking behaviour, information behaviour models, teachers, use of information.

Introduction
The Relevance of the Topic

Information seeking behaviour starts when one realizes the existence of an information need and ends when that need is believed to have been satisfied (Krikelas,1983, as cites in Sawant, 2015). The origins of human information seeking behaviour are found in work on the users of libraries and in readership studies in general. "Information behaviour" is currently preferred term used to describe many ways in which human beings interact with information, in particular, the ways in which people seek and utilize information (Bates, 2017). Information-related behaviour could be described as all human behaviour related to information sources and channels, including the seeking and use of active and passive information. Changes in information seeking behaviour are related to psychological, demographic factors, different areas of life and situations in the use of ICT (information communication technologies), as new patterns of behaviour are formed in interaction with each new communication technology.

Information seeking behaviour, information use and search of behaviour models were investigated during the last 20 years by T. D. Wilson (2000), R. Fidel, A. M. Pejtersen (2004), A. Foster (2005), R. Savolainen (2007, 2010, 2019), H. R. Tabosa, V. B. Pinto, (2015), P. H. Ohtoshi, C. Gottshchalg-Duque (2016), M. J. Bates (2017), D. K. Kundu (2017), M. Kisilowska, A. Mierzecka (2019), J. Steinerová (2019), H. Weber, D. Becker, S. Hillmert, (2019), M. Ridley (2019).

Research Problem

Information seeking behaviour is an evolving field of research that offers many opportunities to explore processes related to information behaviour. Information behaviour research provides a better understanding of how people actually use information in all aspects of life, improving the analysis of information behaviour, processes, and systems in different

information spaces (Ocepek, 2017). Lithuanian scientific literature provides only a few research projects on information behaviour (Janiūnienė, 2012; Vernickaitė, 2014).

Information seeking behaviour of information user is often determined by two things: access to the necessary sources of information and the competencies to access those sources of information. Online information, electronic resources and services are increasingly used in studies and academic research. Access to high-quality electronic information resources is ensured by the academic library of the institution, forming a collection of electronic resources that depends on the study programs and research needs of each institution, as well as the financial capabilities of the institutions.

Scientific literature often deals with problematic issues related to the development of students' information seeking behaviour. Teachers are often thought of as experienced users of information, experts in their fields of research, who link information seeking to their existing knowledge and to the literature already known. Relatively limited research on the problems of information behaviour shows that the research and improvement of teachers' information management competence is relevant and must be directed towards the improvement of the ability to search and use information sources more effectively. Teachers should keep an eye on their own and related research, as well as the latest research published in journal articles or conference proceedings. Ensuring access to the latest scientific information and creating appropriate information environment is a key factor in ensuring successful operation of research and study institutions.

Information seeking behaviour problems have not been analysed at Šiauliai State University of Applied Sciences. Therefore, it is important to analyse information needs of the teachers of Šiauliai State University of Applies Sciences, to find out what information seeking tools they use in information seeking process, and if they choose a suitable and effective information seeking strategy.

Research problem. What is information seeking behaviour of the teachers of Šiauliai State University of Applied Sciences? What information seeking tools are most commonly used to search for scientific information? What are the weaknesses and unemployed opportunities for teachers to use electronic science resources?

Object of the research. Teachers' information seeking behaviour.

The aim of the research. To analyse teachers' information seeking behaviour.

The objectives of the research:

1. Describe information seeking behaviour concept and information behaviour models.

2. Look into Šiauliai State University of Applied Sciences teachers' information seeking behaviour.

The research methods are the analysis of scientific literature, quantitative research (survey).

The Concept of Information Seeking Behaviour

Some definitions have to be introduced before we go further. Two terms are used in this paper: *information behaviour*, *information seeking behaviour*. They are defined as follows:

Information behaviour is the totality of human behaviour in relation to sources and channels of information, including both active and passive information seeking, and information use. Thus, it includes face-to-face communication with others, as well as the passive reception of information as in, for example, watching TV advertisements without any intention to act on the information given (Wilson, 2000).

Information seeking behaviour is the purposive seeking for information because of a need to satisfy some goal. In the course of seeking, an individual may interact with manual information systems (such as a newspaper or a library), or with computer-based systems (such as the World Wide Web) (Wilson, 2000).

T.D. Wilson (1999) pointed out that information search is a subset of information seeking behaviour and that information seeking behaviour is in turn only a subset of all possible information behaviour.

As reported by M. Bates (2017) information seeking behaviour is a term describing information user interaction with information, with particular emphasis on information seeking and its use processes. According to R. Savolainen (2007), information behaviour is an "umbrella" concept that covers all the most important activities of an individual related to information: information needs, information seeking and its use.

The regularities of information seeking and information retrieval have been analysed since the fifth decade of the 20th century. Integral research on information behaviour has been started, the main object of analysis of which is an individual, the peculiarities of his/her information behaviour and the social context of user information behaviour (Janiūnienė, 2012).

During this time, clear boundaries have been drawn between the concepts of information behaviour, information seeking behaviour and information search.

Information Behaviour Models

A model is a repetition of the properties of a research object in another object (model) in order to get to know the research object better (Verslo žinių žodynas/Dictionary of Business Knowledge, 2005). Most models of information behaviour are diverse, models as statements that try to describe information seeking activities, the causes and consequences of those activities, or the relationships between the stages of information seeking behaviour (Kundu, 2017). As R. Savolainen (2019) states, empirically validated models can be called theories, models simplify complex reality to make it understandable. There are all kinds of models of information behaviour, some more complex, others simpler, can consist of only a few components or of several, they can be represented by physical images, diagrams, equations, etc. Some models are more user-centred, others are focused on feelings, sensations, some are tailored to information-seeking behaviours, others are tailored to depict cognitive stages or behaviours. The purpose of the models is to describe information seeking activities, the causes and consequences of those activities, or the relationships between the information seeking phases. Models of information behaviour differ in the number of their elements. Some models consist of several elements, others even a dozen. Key elements of both T. D. Wilson models (1981, 1999), D. Ellis (1997), B. Dervin (1983, 1996 as cites in Wilson, 1999), M. Kisilowska and A. Mierzecka (2019) and Ohtoshi-Gottschalg-Duque (2016) are the user information needs identification, formulation of the user's request, its submission to the information search engine. The main element of the C. C. Kuhlthau (1991) model is the thoughts, feelings and actions of the information user. The main statement of this model is that at the beginning of information seeking, the user's doubt and confusion about the task gradually disappears as the purpose of the search becomes clearer and it is transitioned to the formulation of a specific query. J. Steinerova's (2018) "Interactive Academic Library Model" reflects the information behaviour of the academic community. This model is designed as an interactive space based on interaction and dialogue between academic communities. This Steinerova's model can help create digital services for academic communities, including social network support, project management, publishing strategies, and digital ethics. M. Ridley (2019) presented "Autonomous Information Behaviour Model", this model scheme identifies the main components and their interrelationships and provides a preliminary description of autonomous information behaviour. Autonomous information behaviour describes the way in which artificial intelligence engages in the relevant information space.

The main purpose of Information behaviour models is to describe information seeking activities, their causes and consequences, or the relationships between the stages of information seeking. The main elements of information seeking models are identification of the user's information needs, formulation of the user's request, submission of the request to the information search engine, obtaining relevant search results.

Information behaviour includes three components: information needs, seeking, and its use. According to J. Kari (2010), the use of information is difficult to describe because the concept is vaguely defined. There is no single definition of the correct use of information; it can be understood in different ways. Terminological problems arise in the interpretation of the concept of information use, as related expressions used are often considered synonymous, such as knowledge use, information use, information use and processing (Savolainen, 2009).

In 1989 A. Bouazza provided a definition of the use of information: the use of information is a behaviour designed to seek and retrieve information that is necessary to meet a person's needs. According to C. Maybee (2006), the use of information can also be understood as an information process consisting of various information operations. Similarly, R. F. Rich (1997) suggests that the process of using information should consist of the following events: 1) receipt of information, 2) processing of information, and 3) application of information. The use of information should include actions or steps that usually appear when a need for information is identified. The search is then performed and the information collected. The process can be repeated until the information eventually meets the needs and solves the problem (Maybee, 2006). The use of information includes user behaviour, information seeking, information seeking skills, information use, information literacy, information needs, context. The use of information manifests itself in decision-making and problem solving, in formation of personal attitudes, in sharing of information with others, and in the creation of new knowledge. Use of information is when people search in information sources and take over the information available in them, reading of the information, thinking about the acquired information, comparing, analysing and evaluating information from different sources, adapting and using information.

It is difficult to find even two sources in scientific literature in which the use of information is defined in the same way. Sometimes the use of information is considered to be an almost all-encompassing concept, simply an information phenomenon, in other cases it is limited to a certain part of the use of information. The use of information can also mean different things depending on the context. It can be concluded that the use of information is a multifaceted phenomenon, as any human interaction with information is the use of information. However, it is more common for the use of information to involve the search for sources of information. Use, in turn, is defined as the consideration of all available sources of information in choosing alternative ways of acting or seeking. Behaviour of the use of information consists of physical and mental actions, where the information retrieved is related to the existing knowledge base of the person.

In order to study information behaviour of the teachers of Šiauliai State University of Applied Sciences, a model of information behaviour was developed, based on T. D. Wilson's 1981 and 1999 information behaviour patterns and the Ohtoshi-Gottschalg-Duque 2016 information behaviour model.

From T. D. Wilson's model of 1981 the following elements were taken: information user, need, information behaviour, choice of information systems, choice of other information sources, success, failure, satisfaction / dissatisfaction, information transfer and information exchange. From T. D. Wilson's model of 1999, the following elements were taken: information seeking behaviour and information seeking obstacles. Consumer profile was taken from Othoshi-Gottschalg-Duque's information behaviour model of 2016. Information behaviour model, developed for the research implementation, (see Figure 1) was supplemented with one more element i.e. the use of information.
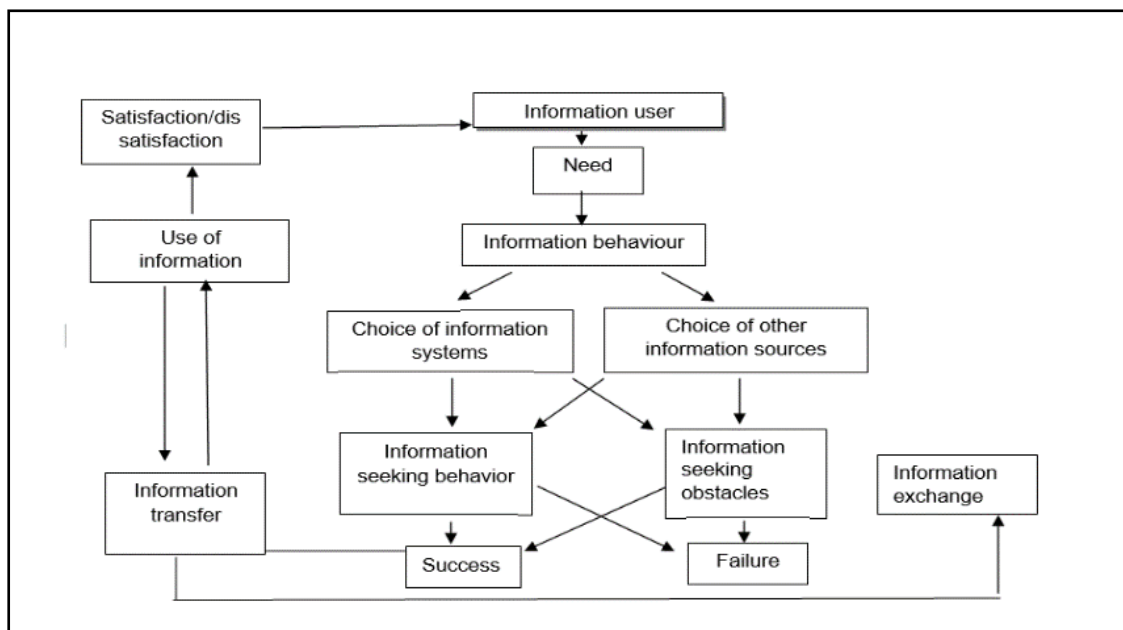
Fig. 1. Model of information behaviour of the teachers

Source: Compiled by the authors of the article, based on T. D. Wilson 1981 and 1999 information behaviour patterns and Othishi-Gottschalg-Duque 2016 model.

Analysing this constructed model of the teachers' information behaviour, we can see that the key element is the information user, the person who will use the information. In order to find out more precisely the information behaviour of each teacher, it is necessary to reveal the user's characteristics, so another element comes out of the user, which is the user's characteristics. In addition, information seeking arises from the need that the user of information perceives in various stages or sequences. In order to meet this need, information user chooses seeking information. Here, information seeking is divided into two other elements, it is information-seeking behaviour (e.g. watching TV) when information may be unintentionally collected, when a person engages in other behaviour or information seeking and accidentally comes across information that is relevant to him in the process (Mowbraj, Hall, Reaside, Robertson, 2017). Purposeful and active information behaviour occurs when an individual seeks information to perform a specific task or make a decision, when knowledge or information is sought to obtain

more or to update it (Vernickaitė, 2016) and information search barriers (e.g. personal barriers (emotional, demographic, education); social and environmental, such as access to resources, economic situation. According to D. K. Kundu, information needs are an essential motivation for information seeking, which depends on an individual's well-being in social life (Kundu, 2017). Information user either finds or does not find the information that meets his/her need. If the information does not meet his needs, then the user of the information can return to the beginning of the model. In the case of success of the information user, the person will use the information and fully or partially will fulfil his/her need. The model also emphasizes the transfer of information to others in the process of using and seeking information, as other people are an important source of information. Information can be passed on to other people (Kundu, 2017). The model shows that a specific need encourages the user to seek access to an information library or other sources of information. If information is found, it can be used and may or may not meet a perceived need in completely or partially. In this case, the user may seek additional information. A person can also seek information from other people and this is referred to as information exchange. The model is based on the assumption that the occurrence of a problem or a tangle of problems causes uncertainty, which in turn leads to efforts to obtain information to master the problem. When the purpose of the person facing the problem is to seek and find an appropriate and acceptable solution to the uncertainty caused by that problem, the information seeking activity carried out for that purpose must be understood as directed towards the objective (Ek, 2017). The formation of user needs is influenced not only by external and internal environment, but also by the characteristics of the sources and the user's interpersonal relationships. Consequently, an individual's information behaviour is influenced by different factors that construct the context of information behaviour and determine the consumer's information search strategy (Stonkienė, Janiūnienė, 2020).

Methodology

In order to analyse Šiauliai State University of Applied Sciences teachers' information seeking behaviour in 2021 from March 26 to April 26 a quantitative research was carried out. All 108 teachers of Šiauliai State University of Applied Sciences were invited to answer the questions of the questionnaire. The respondents participated in the survey voluntarily, and information about this research was provided, indicating the purpose of the research. The respondents were informed that their anonymity and confidentiality would be preserved, and the survey data would only be presented summarized. According to K. Kardelis (2016), the questionnaire survey is the most popular research method used to find out the opinion of the majority of respondents. Therefore, a questionnaire survey was chosen to investigate the information seeking behaviour of the academic staff of Šiauliai State University of Applied Sciences. The questionnaire consists of 15 questions, which are divided into two blocks of questions: demographic questions (4 questions) and diagnostic closed-ended questions (11 questions), which sought to identify specific facts relevant to the research. 108 questionnaires were sent to the teachers of Šiauliai State University of Applied Sciences by e-mail, which they filled in electronically. 73 questionnaires were submitted. The reversibility of the questionnaires accounts for 67,6 percent.

Results

The questionnaire comprised 15 questions, 4 of which were demographic. Having summarized the obtained results, it was found out that 82,2 percent of all the respondents to the questionnaire were women; two-thirds of the respondents were aged 41-60. More than two-thirds of the respondents (69,9 percent) were lecturers, more than one-fifth (21,9 percent) were associate professors, and only a few respondents indicated that they were assistants. The next step was to compare all the responses by the faculties. The total number of submitted questionnaires was 73, 28 of which were received from the Faculty of Health Care (i.e. 38,4 percent), and 45 questionnaires were received from the Faculty of Business and Technologies (i.e. 61,6 percent).

The survey sought to find out the teachers' need for information at Šiauliai State University of Applied Sciences. Multiple choice of 5 answer variants were presented, the respondents were given the opportunity to key in their own alternative responses too (see Table 1).

Table 1

Need for Information
FHC (n = 28), FBT (n = 45), percent

Answer variants	Faculty of Health Care (FHC)	Faculty of Business and Technologies (FBT)
Ensures good preparation for the lectures	85,7	80
Helps to deepen knowledge and improve	75	73,3
Gives self-confidence in a variety of work situations	71,4	57,8
With sufficient amount of information, I can get involved in discussions	32,1	35,6
With comprehensive information, I can plan my work activities	32,1	40
Another alternative	0	0

After the obtained results were summarized, it became clear that information provided to the respondents ensures good preparation for lectures, helps to deepen knowledge and improve, and gives self-confidence in various work situations. It can be assumed that the teachers of Šiauliai State University of Applied Sciences raise their qualification, deepen their knowledge and strive for improvement in their professional activities.

The next question of the questionnaire was to find out how often teachers looked for information when getting ready for the lectures or seminars, preparing teaching materials, writing articles or books. The results of the research showed that the teachers always look for information for the preparation of lectures / seminars. 93 percent of the teachers from the Health Care Faculty and 86,7 percent of the respondents from the Faculty of Business and Technologies claimed this, and 75 percent of the respondents from the Health Care Faculty and 84,4 percent of the respondents from the Faculty of Business and Technologies always look for information for the preparation of teaching materials. The research revealed that 50 percent of the respondents from the Health Care Faculty and 60 percent from the Faculty of Business and Technologies always look for information for the preparation of articles/books.

The obtained results allow us to assume that constant updating of the teaching material can be explained by the specifics of his/her field, the teacher actively participates in the study process, formulates academic assignments, assesses them and provides consultations on the subject.

The research found out that more than three-quarters of all the respondents purposefully look for information, having a specific task, and browsing the Internet. A quarter of them indicated that they visit library to get the information they need. The results obtained state that the teachers of Šiauliai State University of Applied Sciences carry out information seeking independently, purposefully, having considered their information needs and goals.

The research discovered that more than three-quarters of the respondents from both faculties take advantage of databases as their primary source of information, with more than a half of all the respondents indicating that the Internet (Internet sources) is their primary source of information. The results suggest that the choice of the Internet as the primary source may mean lack of time, as the Internet is a convenient tool available 24/7, but in this pandemic period it can be assumed that the Internet and databases are the only sources available from home, as distance learning took place through nearly all 2020-2021 academic year.

The next question of the questionnaire was intended to find out how often teachers use information search engines to search for information. 5 information search engines were provided and the respondents were asked to indicate how often (always, sometimes, rarely, never) they took advantage of them (see Table 2).

Table 2

Frequency of Use of Information Search Engines
FHC (n = 28), FBT (n = 45), percent

Answer variants	Always	Sometimes	Rarely	Never
	FHC / FBT	FHC / FBT	FHC / FBT	FHC / FBT
Google	82,1 / 88,9	10,7 / 6,7	7,1 / 4,4	0 / 0
Google Scholar	53,6 / 48,9	25 / 31,1	14,3 / 8,9	7,1 / 11,1
Google Books	39,3 / 22,2	21,4 / 55,6	28,6 / 17,8	10,7 / 4,4
WorldWideScience.org	3,6 / 11,1	35,7 / 26,7	32,1 / 51,1	28,6 / 11,1
ScienceResearch.com	10,7 / 28,9	32,1 / 35,6	35,7 / 22,2	21,4 / 13,3

The research found out that almost one-third (28,6 percent) of Faculty of Health Care and 11,1 percent of the respondents from Faculty of Business and Technologies did not use the specialized science search engine WorldWideScience.org., where the user of information can find scientific information from national and international academic databases and portals around the world. One-fifth (21,4 percent) of the respondents from the Faculty of Health Care and 13,3 percent respondents from Faculty of Business and Technologies have never used the specialized information retrieval system ScienceResearch.com, a great information retrieval tool that provides access to more than 400 top-quality science and technology collections specifically designed for advanced research. It can be stated that some teachers of Šiauliai State University of Applied Sciences are not familiar with academic search engines, which would allow expanding the horizon of information search, to find more diverse, rarer, more relevant sources of information. It can be assumed that due to the abundance of information retrieval tools, information users (the teachers of Šiauliai State University of Applied Sciences) choose the resources that are the most easily accessible and offer the largest selection of necessary sources.

The research discovered that the respondents from both faculties prefer interactive (electronic) sources (75 percent of FHC respondents and 84,4 percent of FBT respondents) due to distance learning during the Covid-19 pandemic, as information resources are available 24/7. It was found out that more than 90 percent of the respondents from both faculties would choose printed information resources for comfortable reading. It can be assumed that printed documents are more convenient to read for the "Baby Boomer" and Generation X people, whose reading habits had developed even before the availability of electronic documents, as the survey demographic data shows that only one-fifth of the respondents do not belong to these generations available in the survey.

The survey revealed that more than two-thirds (82,1 percent of FHC and 75,6 percent of FBT) of the respondents indicated that they choose interactive sources of information because of their fast and timely access. More than a half of all the respondents claim that they choose electronic sources of information because an electronic link can be provided to students. The obtained results allow stating that teachers' information seeking behaviour, use of information sources, knowledge of information technologies and the ability to use them in information seeking, informally develops the student's information skills.

The analysis of the obtained survey data revealed that the respondents from both faculties use the Internet (resources available on the Internet) very often as much as 89,3 percent from the Faculty of Health Care and 86,7 percent from the Faculty of Business and Technologies. It can be assumed that the respondents feel advantageous to use one-stop search tools that provide access to information from various databases, directories, indexes, web pages, etc. by keying in search keywords in the search box.

Analysing the questionnaire responses of the survey, it was found out that almost all the respondents (FHC 96,4 percent and FBT 97,8 percent) exchange information with students. More than a half of all the respondents share information found in both faculties with their colleagues.

The last question of the questionnaire was intended to find out the obstacles to information seeking. Six activities were introduced and options presented always, sometimes, rarely, never. The distribution of respondents' responses is presented in Table 3.

Table 3

Information Seeking Obstacles by Frequency
FHC (n = 28), FBT (n = 45), percent

	Always	Sometimes	Rarely	Never
	FHC / FBT	FHC / FBT	FHC / FBT	FHC / FBT
Lack of time	14,3 / 20	75 / 68,9	10,7 / 8,9	0 / 2,2
I don't know where to look for	0 / 0	25 / 26,7	60,7 / 53,3	14,3 / 20
Unable to find what I'm looking for	0 / 0	57,1 / 51,1	39,3 / 42,2	3,6 / 6,7
I don't like to ask for help when looking for information	10,7 / 15,6	53,6 / 51,1	28,6 / 24,4	7,1 / 8,9
I don't like going to the library	0 / 2,2	25 / 35,6	42,9 / 46,7	32,1 / 15,6
I don't have internet access	0 / 0	3,6 / 11,1	14,3 / 15,6	82,1 / 73,3

The analysis of the data obtained revealed that lack of time was a major obstacle, with around three-quarters of all the respondents indicating that they are sometimes short of time to search for information. Such statement confirms the results obtained in the previous responses to the questionnaire that the choice of the Internet as the primary search resource testifies to the lack of time to search for information. The respondents' good information retrieval skills is confirmed by the fact that two-thirds (60,7 percent) of FHC respondents and more than a half (53,3 percent) of FBT respondents rarely find themselves in a situation when they do not know where to look for information. Moreover, about a half of all the respondents rarely fail to find what they are looking for. The survey confirmed that more than three-quarters of the respondents always have access to the Internet, which is very important because the study process in the 2020-2021 academic year due to the Covid-19 pandemic took place remotely and probably only technical problems sometimes hampered information seeking.

To sum up, we can state that the main obstacle to information seeking is the lack of time. It can be assumed that the teachers of Šiauliai State University of Applied Sciences have a high workload.

Conclusions

1. Information seeking behaviour is comprehended as a process during which the user perceives his problem task, identifies information needs, and understands the space for information use. Information behaviour includes all the most important activities: information needs, information seeking and its use. The models of information behaviour differ in the number of their elements. Some models consist of several elements, others even of a dozen. Key elements of information seeking models are identification of user information needs, formulation of user request, submission of the request to information search system, obtaining relevant search results. In order to find out information behaviour of Šiauliai State University of Applied Sciences teachers information behaviour model was developed following T. D. Wilson 1981 and 1999 and Othishi-Gottschalg-Duque 2016 models of information behaviour, where the key elements are user information needs, information sources, information seeking process, and the obstacles of information seeking.

2. After the analysis of information behaviour of the teachers of Šiauliai State University of Applies Sciences, it can be stated that information needs of the teachers are related to the preparation for the lectures, deepening and improvement of knowledge. The respondents first look for information in databases and on the Internet. The information found is shared with students and colleagues. The analysis of the search tools used by the teachers revealed quite clear priorities for the search tools used. Universal search engines such as Google are commonly used to search for information. The research revealed that the teachers of Šiauliai State University of Applied Sciences value the simplicity of the user interface of universal search engines, therefore they often use the specialized information search tool Google Scholar, where they find scientific information from freely available or subscribed resources. When summarizing the use of search resources by the teachers, it can be noted that the teachers of both faculties of Šiauliai State University of Applied Sciences very often use universal information search tools. Therefore, it can be stated that the teachers of Šiauliai State University of Applied Sciences often do not choose the most appropriate and effective methods of searching for scientific information, do not use all the possibilities of searching for scientific information, which would expand the horizon of information search. The conducted research allows to state that teachers of Šiauliai State University of Applied Sciences need to develop Information seeking behaviour competencies, to organize training sessions, during which they would get acquainted with the new, more advanced search tools, ways to find and obtain information sources. It is necessary to change information retrieval habits and develop strategies for effective information retrieval.

References

1. Bates, M. J. (2017). *Information Behavior.* Retrieved from https://infocom.hyperlib.sjsu.edu/wp-content/uploads/2019/07/information_behavior_bates.pdf.

2. Bouazza, A. (1989). Information user studies. *Encyclopedia of Library and Information Science* (T. 44, p. 144–164). London: Taylor and Francis.

3. Ek, S. (2017). *Factors relating to problems experienced in information seeking and use: findings from a cross-sectional population study in Finland.* Retrieved from http://informationr.net/ir/22-4/paper775.html.

4. Ellis, D. (1997). Modelling the Information Seeking Patterns of Engineers and Research Scientists in an Industrial Environment. *Journal of Documentation, 53*(4), 384–403. Retrieved from

https://www.researchgate.net/publication/228801580_Modelling_the_Information_Seeking_Patt erns_of_Engineers_and_Research_Scientists_in_An_Industrial_Environment.

5. Fidel, R., & Pejtersen, A.M. (2004) From information behaviour research to the design of information systems: the Cognitive Work Analysis framework. *Information Research*, *10*(1), paper 210. Retrieved from http://InformationR.net/ir/10-1/paper210.html.

6. Foster, A. (2005). A Non-Linear Model of Information Seeking Behaviour. *Information research, 10*(2), [1–23]. Retrieved from ERIC.

7. Janiūnienė, E. (2012). Studentų informacinę elgseną motyvuojantys veiksniai. *Informacijos mokslai*, *61*, 83-92. Retrieved from https://doi.org/10.15388/Im.2012.0.1067.

8. Kardelis, K. (2016). *Mokslinių tyrimų metodologija ir metodai: vadovėlis*. Vilnius: Mokslo ir enciklopedijų leidybos centras.

9. Kari, J. (2010). *Diversity in the conceptions of information use.* Retrieved from http://informationr.net/ir/15-3/colis7/colis709.html.

10. Kisilowska, M., & Mierzecka, A. (2019). *Emotions, experiance, identity – motivations of the teens information behavior in the area of culture.* Retrieved from http://informationr.net/ir/24-1/isic2018/isic1826.html.

11. Kuhlthau, C. C. (1991). Inside the search process: Information Seeking from the Users Perspective*. Journal of the American Society for Information Science, 42*(5), 361–371. Retrieved from https://ils.unc.edu/courses/2014_fall/inls151_003/Readings/Kuhlthau_Inside_Search_Process_ 1991.pdf.

12. Kundu, D. K. (2017). Models of Information Seeking Behaviour: A Comparative Study.
International Journal of Library and Information Studies, *7*(4), 393–405. Retrieved from https://www.researchgate.net/profile/Dipak-Kundu-3/publication/343306380_Models_of_Information_Seeking_Behaviour_A_Comparative_Study/li nks/5f2295a3458515b729f33b76/Models-of-Information-Seeking-Behaviour-A-Comparative-Study.pdf.

13. Maybee, C. (2006). Undergraduate perceptions of information use: the basis for creating user-centered student information literacy instruction. *The Journal of Academic Librarianship*, *32*(1), 79-85. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0099133305001369.

14. Mowbraj, J., Hall, H., Reaside, R., & Robertson, R. (2017). *The role of networking and social media tools during job search: an information behavior perspective.* Retrieved from http://informationr.net/ir/22-1/colis/colis1615.html.

15. Ocepek, M. G. (2017). *Bringing out the everyday in everyday information behavior.* Retrieved from https://www.researchgate.net/publication/320675784_Bringing_out_the_everyday_in_everyday _information_behavior.

16. Ohtoshi, P. H., & Gottshchalg-Duque, C. (2016). *A new Model of Information Behavior Based on Semantic Modeling.* Retrieved from https://asistdl.onlinelibrary.wiley.com/doi/pdf/10.1002/pra2.2016.14505301081.

17. Rich, R. F. (1997). Measuring knowledge utilization: processes and outcomes. *Knowledge and Policy*, *10*(3), 11–24. Retrieved from https://link.springer.com/article/10.1007%2FBF02912504.

18. Ridley, M. (2019). *The autonomous turn in information behavior.* Retrieved from http://informationr.net/ir/24-1/isic2018/isic1832.html.

19. Savolainen, R. (2009). *Epistemic work and knowing in practice as conceptualizations of information use*. Retrieved from http://www.webcitation.org/5sfbnEx8A.

20. Savolainen, R. (2010). *Everyday Life Information Seeking*. Retrieved from https://infocom.hyperlib.sjsu.edu/wp-content/uploads/2018/08/Everyday-Information-Seeking_Savolainen.pdf.

21. Savolainen, R. (2007). Information behavior and information practice: reviewing the "umbrella concepts" of information seeking studies. *The Library Quarterly, 77* (2), 109–132. Retrieved from https://www.journals.uchicago.edu/doi/10.1086/517840.

22. Savolainen, R. (2019). Modeling the interplay of information seeking and information sharing: A conceptual analysis. *Aslib Journal of Information Management*, *71*(4), 518–534. Retrieved from https://doi.org/10.1108/AJIM-10-2018-0266.

23. Sawant, S. S. (2015). Krikelas model of Information seeking behavior (1983). In Al-Suqri & AL-Aufi (Eds.) *Information Seeking Behavior And Technology Adoption: Theories And Trend* (p. 82-93). Hershey, PA : IGI Global. Retrieved from https://www.igi-global.com/viewtitlesample.aspx?id=127124&ptid=120225&t=Krikelas%27%20Model%20of%20 Information%20Seeking%20Behavior%20(1983)&isxn=9781466681569.

24. Steinerová, J. (2019). The societal impact of information behaviour research on developing models of academic information ecologies. *Proceedings of CoLIS, the Tenth International Conference on Conceptions of Library and Information Science, Ljubljana, Slovenia, June 16-19, 2019*. Retrieved from http://www.informationr.net/ir/24-4/colis/colis1905.html.

25. Stonkienė, M., & Janiūnienė, E. (2020). Tinklalaidės neformaliajame mokymesi: socialinių medijų naudojimas asmeninės mokymosi aplinkos, asmeninio mokymosi tinklo kūrimui. *Informacijos mokslai*, *88*, 46-65. Retrieved from doi.org/10.15388/Im.2020.88.31.

26. Tabosa, H. R., & Pinto, V. B. (2015). *Analysis of information use and search of behavior models in dissertations and theses of PPGCI: A proposal to broaden in the Ellis Model.* Retrieved from 279330631_Analysis_of_information_use_and_search_behavior_models_in_dissertations_and _theses_of_PPGCI_A_proposal_to_broaden_in_the_Ellis_Model.

27. Vernickaitė, A. (2014). Parlamentarų informacinės elgsenos ypatumai*: Lietuvos Respublikos Seimo narių atvejis. Parlamento studijos*, *15*, 66–97. Retrieved from *http://www.parlamentostudijos.lt/Nr15/15_informacija_1.htm*.

28. *Verslo žinių žodynas.* (2005). Retrieved from http://zodynas.vz.lt/.

29. Weber, H., Becker, D., & Hillmert, S. (2019). Information-seeking behaviour and academic success in higher education: Which search strategies matter for grade differences among university students and how does this relevance differ by field of study?. *High Educ, 77*, 657–678. Retrieved from https://doi.org/10.1007/s10734-018-0296-4.

30. Wilson, T. D. (2000). Human Information Behavior. *Special Issue on Information Science Research, 3*(2), 49-55. Retrieved from http://inform.nu/Articles/Vol3/v3n2p49-56.pdf.

31. Wilson, T. D. (1999). Models in information behavior research. *Journal of Documentation, 55*(3), 249-270. Retrieved from https://www.researchgate.net/publication/228784950_Models_in_Information_Behaviour_Research.

PROBLEM BASED LEARNING DURING CONTACT AND ONLINE LEARNING

Virginija Jarulė
Vilniaus kolegija / University of Applied Sciences
Lithuania

Annotation

The aim of this article is to present the analysis of assessment objects – motivation, group work, assessment/self-assessment, skills formation, performed during problem-based learning in different student learning conditions. The essence of problem-based learning is to learn to solve problems by working in groups or teams, to search for information independently, to develop problem – solving strategies, to evaluate the work which was done. During a pandemic, online learning poses challenges for students to work in groups and assign tasks, as well it is more difficult to communicate and collaborate, which can make it more difficult to develop the necessary skills.

Key words: problem-based learnig, PBL, contact learning, online learning.

Introduction

Problem-based learning is relevant to today's students and is widely applied around the world. PBL aims to foster a wide range of skills such as communication and collaboration skills, decision making, problem solving, critical thinking, and self-directed learning (Wilder, 2014). Problem-based learning (PBL) is a teaching style that pushes students to become the drivers of their learning education.

Problem-based learning strategy is a didactic innovation that has been widespread in America, Canada, Australia, Benelux, Scandinavia since the 1980s. In PBL, the use of real, ill-structured problems provides a context for the development of students' knowledge and skills (Reich et al., 2007). An important aspect in preparing a comprehensive professional is the combination of special, social, and personal abilities. The development of personal skills does not necessarily require separate subjects, and in most cases these skills can be developed alongside special subjects using a variety of methods. For example, when studying a specialty subject, students are given the task of solving a problematic situation – this develops personal skills to organize and plan their activities, solve problems, respond flexibly to change; or to carry out a joint project with course colleagues – thus developing social skills – communication and cooperation. In this way, future veterinary specialists acquire more independence, information literacy, teamwork skills, are able to better analyze their own and colleagues' work process and results (Balkevičius, Jarulė, 2017).

Digital education is changing the way in which health professions education, including PBL, is conducted. Although there is evidence on different applications of digital technology in PBL, it is still unclear how effective it is to integrate digital technology within PBL as compared to traditional PBL (Jin & Bridges, 2014).

According to B. Aleksandravičiūtė and K. Liekis (2020), the culture of individual teaching and learning prevails in general education and higher education institutions in Lithuania. However, it is team tasks that help to form competencies that are highly valued in today's job market, because teams are a essential for modern organization, so it is not for nothing that we are constantly looking for answers how to make teams work as effectively as possible, because the basic premise of teamwork is that the whole is better than the sum of its parts, which manifests itself in coordinating activities, cooperating (working together), and acting honestly.

In Vilnius College the veterinary study program, the problem-based learning methodology has been applied since 2016. Students work in groups to analyze specific clinical situations. It is especially important for future veterinarians to work in a team, because the results of teamwork are much better than working individually. Until the spring of 2020, problem-based learning took the place in college, through contact. From 2020 March we had to move to online learning, as things changed quickly and drastically, it was interesting to compare how a problem-based learning strategy works online.

Relevance of the research. The Covid-19 pandemic has posed significant challenges to the learning process, as most institutions conduct their studies remotely. Problem-based learning has been used in biomedical studies at the College for some time, so in such an extraordinary situation, it was interesting to compare how the problem-based learning strategy works in contact and online learning.

Research object: the strategy of problem-based learning during contact and online courses.

Aim of the research: to compare the effectiveness of problem-based learning during contact and online learning.

Objectives of the research:

1. To analyze students' motivation in solving problematic situations during contact and online learning.

2. To analyze the advantages and disadvantages of group work during contact and online learning.

3. To study students' attitudes towards assessment and self-assessment.

4. To find out how analytical, communication, work planning, group work, problem solving skills and abilities are formed during contact and online learning.

Research methods. Survey data analysis.

Literature review

Problem-based learning (PBL) has been used as an educational approach in health professions education in many medical and nursing school curricula worldwide for over 50 years (Lim, 2012). Learning in PBL is student centered and occurs in small collaborative groups while teachers take on the role of tutors. Although its implementation varies across different settings, PBL, in general, is an iterative process consisting of three parts: a problem-presentation and analysis phase, a self-directed learning phase, and a synthesis and reporting phase (Yew & Goh, 2016). The team-based teaching / learning strategy is widely applied in higher education various fields of studies and in various programs: most widely in biomedicine and social sciences (Aleksandravičiūtė, Liekis, 2020). There are not many examples in the theory and practice of veterinary didactics on how to correctly create and analyze the problems of a veterinary nurse according to the problem-based learning strategy (Balkevičius, Jarulė, 2016). In the process of problem-based learning, students gain new knowledge through self-directed learning, and lecturers act as facilitators who oversee the group learning process. The result of problem-based learning is the development of certain problem-based learning skills. A problem situation is a short story that encodes a specific problem, a learning object that learners need to reveal, describe, analyze, and solve in a self-directed learning process with the help of a facilitator (Balkevičius, Jarulė, 2017). According to Savin-Baden (2004), problem situations must reflect the context and content of the subject.

In higher education, teaching according to the problem-based teaching methodology is replaced by a process of facilitation, which helps to create constructivist and socio-constructivist learning environments that better realize the principles of modern learning such as constructivism, self-government, cooperation and contextuality. The facilitation process provides an opportunity for the learner to take personal responsibility for their own learning process while working and learning, solving problems in the professional field more independently (Balkevičius, Jarulė, 2016).

A well-chosen evidence-based practice (EBP) teaching / learning strategy in the nursing study program provides more opportunities to link the theoretical and practical training of future nurses to ensure a quality clinical teaching experience. By learning through the five-step teaching model of the EBP, students think, ask questions, and take action, realizing that they have the power to change the world around them. The student is interested to received information, he / she is looking for ways to obtain, store, process and assimilate the information. The teacher remains only the role of an observer, a facilitator, and the student also independently forms his / her own approach to the organization of nursing (Šakalytė, Indrašienė, 2021).

Many traditional learning methods can be transferred to the virtual space. Methods such as lecture, discussion, debate, case study, repetition and consolidation, educational games, experimentation, search for new resources, exploration, practice exercises, tasks that require creative thinking, and so on can be applied remotely (Brazdeikis et al., 2020).

Digital technology primarily supports PBL principles and processes by enabling contextual and collaborative learning (Verstegen et all., 2016). According Elzainy et al. (2020), most of the students were unsatisfied with how some staff members practiced e-learning. However, more research has been done, such as Tudor et all. (2019) states, that Digital Problem Based Learning (DPBL) is as effective as traditional PBL and more effective than traditional learning in improving knowledge. DPBL may be more effective than traditional learning or traditional PBL in improving skills. Further studies should evaluate the use of digital technology for the delivery of other PBL components as well as PBL overall.

Methodology

The surveys were conducted in 2019–2021, after completing the disciplines during which problem-based learning was applied. The questionnaire was submitted to the 3rd year students of the Vilnius College Veterinary Study Program. The questionnaire was first submitted in 2019, during contact learning, in 2021 the same questionnaire was provided during online learning.

In both cases, four assessment objects were assessed – motivation, group work, assessment/self-assessment and development of skills and abilities. Five attributes/control statements of the assessment objects were selected for each assessment object. The assessment objects were compared with each other, their similarities and differences during contact and online learning were analyzed.

In the first study (2019) the questionnaire was provided to 52 students, in the second study (2021) the number of respondents was slightly lower – 49.

How the lectures were conducted according to the problem-based learning methodology? During the study of the clinical subject, a small group of students (4-5 people) received a problematic situation. A problem situation is a short story that encodes a problem(s) that needs to be clarified and solved by students working independently in work groups, according to a problem-based learning methodology. The problem situation must be complex – involving various actors and factors. The problem situation encodes a problem in the range of competencies of a veterinarian - i.e. the problem can be identified as a consequence of the actions or omissions of the veterinarian (i.e. the activities for which he is responsible) or a particular disease/pathology that needs to be disclosed and explained. Problem situations do not arise out of nowhere, they are created according to the content of the subject taught and are usually taken from real past or imaginary clinical cases or situations. Students who receive a problem situation must first draw a picture / draw a scheme / photoshoot or find a picture online that best describes the specific situation. After that, students have to raise questions according to which they tried to unravel in that problematic situation. After students present the problematic situation and what issues they raised. Students filled information in a problem diagram, in which they identified the type of problem, distinguished the main and secondary problems, purpose of solving the problem. They also provided success criteria for solving the problem and commented on the scheme of the problem. They also completed an information source analysis scheme, citing literature sources where they found information on the issues raised. After that, they developed a problem-solving strategy, which described the causes of the problem under analysis, described ways to prevent such problems, and the methodology of correct action of the actors. In the problem solving monitoring work template, the problem solving strategies were combined with the problem solving goal and the problem solving success criteria. The presentation of the problem situation takes place in PowerPoint in collaboration with all the members of the group. Everyone presents their contribution to a problematic situation. The presentation is followed by a brief discussion of the problematic situation. The analyzed problem situations help to develop not only subject but also general competencies (learning to learn, communication, cognition and creativity).

Problem-based tasks are related to real situations in the clinic or elsewhere that need to be investigated, thus developing cognitive skills: to formulate a problem clearly, to create a model for its solution, to perform the necessary procedures and to relate the result to the initial situation. While solving tasks, students analyze a variety of information, look for relationships and patterns, formulate conclusions, and try to substantiate their decisions or conjectures in a variety of ways.

In Lithuania, the application of problem-based learning methods to both veterinary nurses and veterinary surgeons is an area of little research. Research papers focusing on PBL teaching veterinary professionals has not been detected.

After completing the problem-based learning course, students are given a questionnaire to fill, the results of which are presented in this article.

The results of the study were summarized, analyzed and conclusions were drawn.
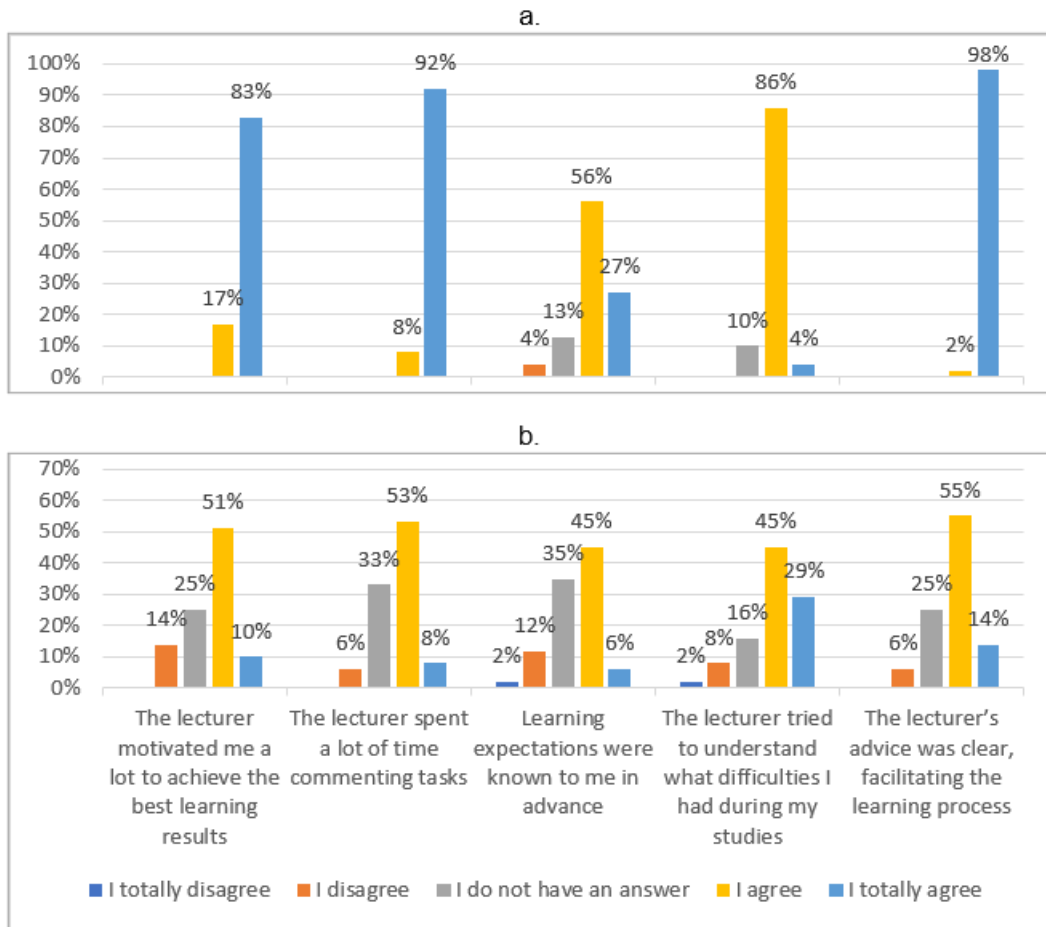
Results and Discussion

Fig. 1. a. Assessment of students' motivation during contact learning; b. Assessment of students' motivation during online learning

During online work, students' motivation (Fig. 1., b.) was significantly reduced, by just over 60 percent of students stated that the teacher motivated them to achieve the best learning results, spent a lot of time commenting on the assignments, the lecturer's advice was clear, and the lecturer tried to understand the difficulties encountered during learning. Learning expectations were clear for 51 percent of students, almost 35 percent had no answer to this, and for 14 percent of students learning expectations were completely unclear.

According to Šakalytė D. and Indrašienė V. (2021), the teaching of evidence-based practice based on simulation and clinical scenarios increases students' interest in EBP. Frame et al. (2016) state that applying an evidence-based practice strategy provides greater satisfaction for students.

It can be said that during online teaching, more video material with clinical scenarios and simulations using mock-ups, mannequins, or virtual clinic / laboratory devices should be introduced to stimulate greater student interest and motivation.
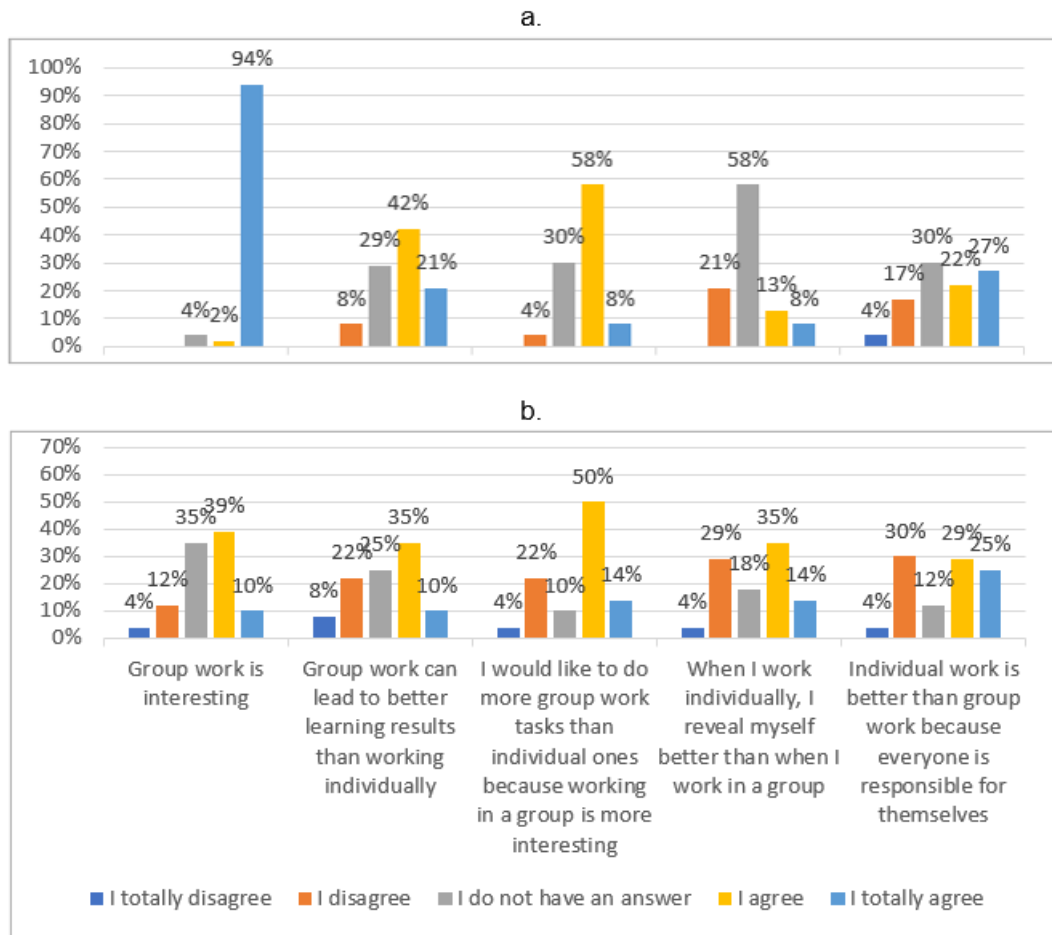
a.

b.

Fig. 2. a. Assessment of group work during contact learning; b. Assessment of group work during online learning

94 percent of students who studied through contact (Fig. 2., a.) said that group work is interesting. 63 percent of students said that better learning results could be achieved through group work, 29 percent did not know the answer and 8 percent argued the opposite. Two-thirds of students (66%) said that they would like to do group tasks more often, 30 percent had no opinion and 4 percent argued the opposite. 21 percent of students believe that they reveal themselves better by working individually, 58 percent have no answer to the question and 21 percent argues the opposite. 71 percent said that individual work is better than group work, because during it everyone is responsible for themselves, 12 percent do not know the answer 17 percent argued the opposite.

During online learning (Fig. 2., b.), only 49 percent said that group work is interesting, 35 percent had no opinion and 14 percent argued the opposite. That group work can achieve better learning results than working individually said 45 percent of students, 25 percent had no opinion and 30 percent argued the opposite. 64 percent of students said they would like to do more group tasks, 10 percent had no opinion and 26 percent argued the opposite. 49 percent of students said that working individually is better than working in a group, 18 percent did not have an opinion, 33 percent argued the opposite. 54 percent of students think that individual work is better than group work, 12 percent did not have an opinion, 34 percent argued the opposite.

Group work – division of students' work, was relevant only during contact work. During the online learning, the task was usually performed by one student, in rare cases others provided comments.

Šakalytė D. and Indrašienė V. (2021) atter the analysis of the articles, state that the combination of lectures, group discussions, team and individual learning/teaching is effective. According to Nokes-Malach et al. (2015) the key question is not whether collaboration benefits learning, but how and when collaboration improves outcomes.

Kyriakoulis et al. (2016) state that teaching through evidence-based practice and in order to increase student engagement and promote their learning experiences it is recommended to include traditional and interactive teaching methods: traditional lectures, computer sessions, group discussions, classes or a combination of these methods.

During online learning, students are more likely to work individually rather than in groups. To make group work more interesting way during online learning, students should be more motivated and directed in the direction that tasks should be distributed and that they should communicate and collaborate more. It can be assumed that some students feel isolated during a pandemic and that collaboration with colleagues becomes difficult for them. As a result, one or two students often take the lead in the task, while others play only the role of passive observers.
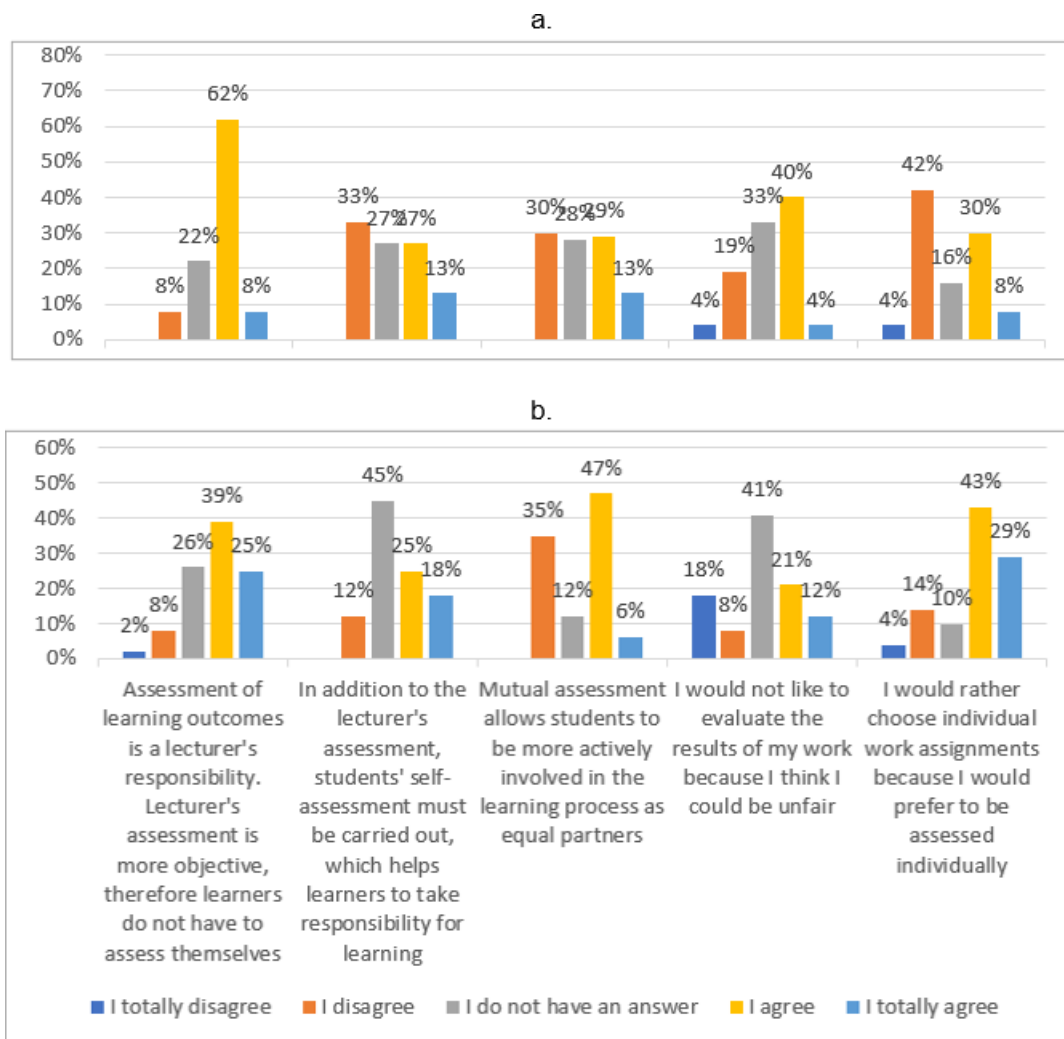

Fig. 3. a. Assessment/self-assessment during contact learning; b. Assessment/self-assessment during online learning

Similar number of students studying both contact and online (70 percent and 64 percent) considered that the assessment of learning results is the responsibility of the lecturer (Fig. 3.). 40 percent of contact students and 43 percent online learning students think that students' self - assessment must also be carried out in addition to the lecturer's assessment.

42 percent of contact learning students and 53 percent online learning students believe that mutual assessment allows students to be more actively involved in the learning process as equal partners. The number of students who disagreed with this opinion was very similar – 30 percent and 35 percent respectively. 44 percent of students who studied in contact and 33 percent of online learning students would not like to evaluate the results of their work, respectively 23 percent and 26 percent, of the rest had no opinion on the matter.

38 percent of contact students and even 72 percent of online learning students would prefer to be assessed individually (would choose individual tasks). 46 percent of contact students and 28 percent of studying at an online would not want to be individually assessed and 28 percent online-learning students, others had no opinion on the matter. This suggests that during online learning, students are more likely to do tasks individually, it is difficult for them to form and maintain a team. In addition, in the comments section of the questionnaires, several students noted that during online learning, the task is usually performed by one student, others seldom provide comments, and usually only agree with the colleague who performed the task without interfering in the task.

Aleksandravičiūtė B. and Liekis K. (2020) believe that every student and teacher probably had some negative teamwork experience. So it's natural if students can take a negative view of teamwork. Therefore, it is very important to properly explain how the team-based learning strategy works. And it is crucial to clarify all levels of responsibility / accountability. It is mentioned that there are several of them. First of all, it is an individual test during which the student's preparation is checked. This is an important part, but much more important and motivating part is the team test and the team task. However, in a team-based teaching / learning strategy, there is another point – the student's score for each other.

Most of the students think that the teacher should evaluate. Although about half of the students believe that mutual assessment allows students to be more actively involved in the learning process as equal partners, most would not want to self-assess. This trend is not very different during both contact and online learning. However, even 72 percent of online learning students would prefer to be assessed individually (would choose individual tasks) while only 38 percent would do so during contact work. This shows that online learning leads to individual learning, making it harder for students to focus and work in teams.
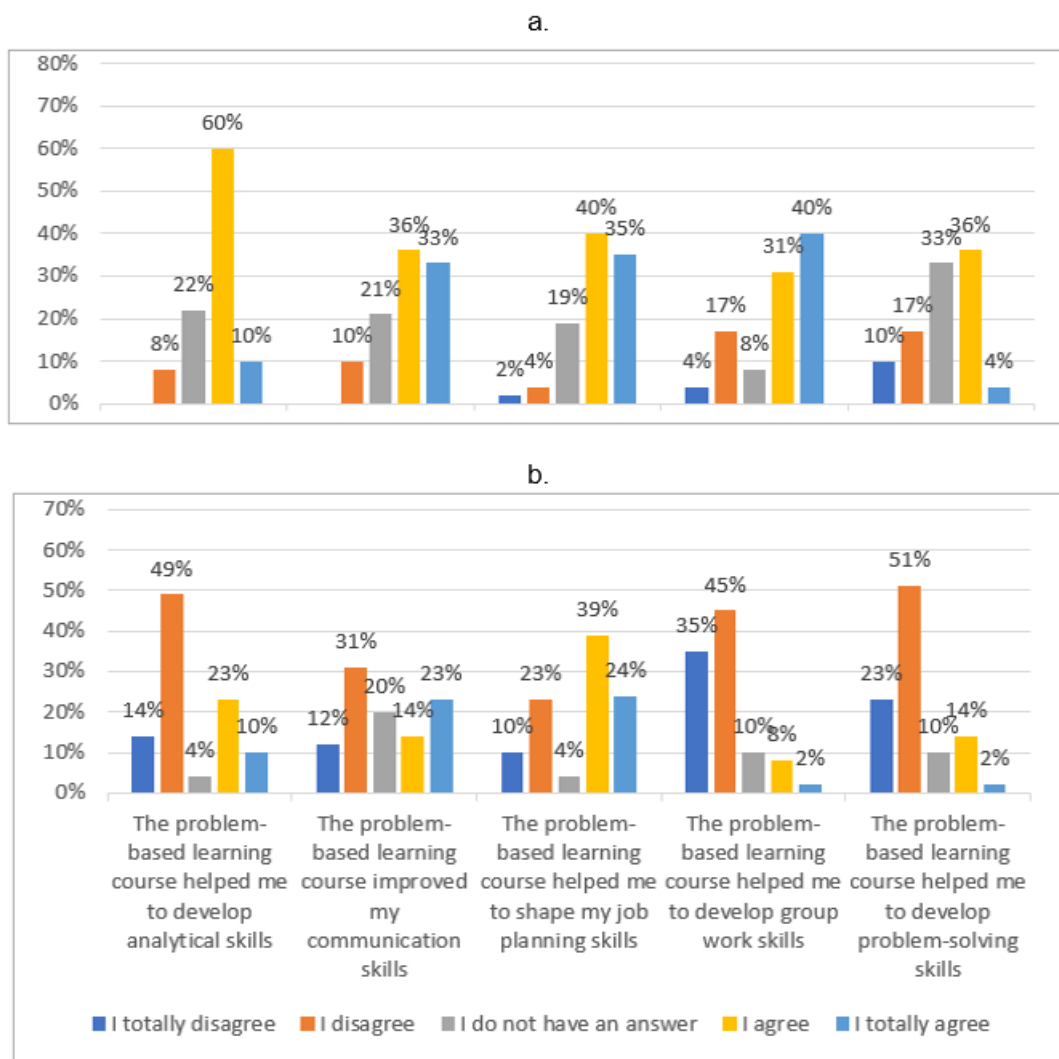
Fig. 4. a. Assessment of skills and abilities development during contact learning; b. Assessment of skills and abilities formation during online learning

The problem-based training course helped to form the analytical skills for 70 percent contact and 33 percent online learning students (Fig. 4.). 8 percent of contact and even 63 percent of online learning students think that analytical skills were not formed.

Communication skills were improved by 69 percent of contact and 37 percent of online-learning students, 10 percent and 42 percent students respectively think that they did not improve these skill. Students noted that it was more difficult for them to communicate remotely because "thoughts kept diverting somewhere else", "more important jobs would appear," or "communication was simply hindered by other family members".

75 percent of contact and 63 percent of online-learning students thinks that improved job planning skills, that did not improve these skills, thinks 6 percent and 33 percent of students respectively. Students studying in a contact way noted that they tried to plan the work so as not to be entrusted to the team members, therefore they always tried to complete the tasks assigned to them on time. Several online-learning students envisioned task work planning as a combination of study with their own work rather than with the team with which they had to perform distributed tasks.

Teamwork skills improved by 71 percent of contact and 10 percent of online learning students, 21 percent of contact and 80 percent of online-learning students did not improve their skills. Problem solving skills were formed by 40 percent of contact and 16 percent of online learning students, 24 percent of contact and 74 percent of online learning students have not developed these skills.

According to Lehane et al. (2017), applying an interactive teaching/learning strategy, students are encouraged to creatively develop both general and special nursing professional skills. Aronoff et al. (2017) state that the inclusion of evidence-based practices in e. learning modules into the study process, students acquire and consistently develop knowledge of EBP and engage in interprofessional evidence-based activities.

Online working students do not always go deep enough into the tasks, they often leave decisions responsibility for teammates, so the survey data show that group work skills improved for 70 percent of contact and only 10 percent of online learning students. Problem solving skills were formed for 40 percent of contact and 16 percent of online learning students. The problem-based learning course helped to develop analytical skills and improved communication skills by about 70 percent of contact and more than 30 percent of online learning students. And only job planning skills were improved by a similar number of learners in both ways (75 percent contact and 63 percent online learning students). This shows that it is not enough to present tasks in the same way as in contact work, therefore, the tasks and the ways of presenting them need to be improved in order to motivate and interest the student as much as possible.

Conclusions

1. During contact teaching, solving problematic situations, students' motivation was high, almost 100 percent. During online learning, students' motivation is significantly reduced – only a little more than 60 percent of students said that the teacher motivates them to achieve the best results, spends a lot of time commenting on tasks, gives clear advice.

2. 94 percent and 63 percent said that group work is interesting and that better learning results can be achieved, the same opinion had 49 percent and 45 percent of online learning students. Group assignments are acceptable for approximately 65 percent of students, regardless of the way their studies are conducted, but only 21 percent of contact learning students think that they are better revealed during individual work and almost half (49 percent) of online students thinks the same.

3. The vast majority of students studying in both ways consider assessment to be the responsibility of the lecturer, but almost half agree that mutual assessment allows students to participate more actively in the teaching process as equal partners and that in addition to teacher assessment, students must self-assess. Only about a quarter of students would like to evaluate the results of their work, 33 percent of contact and 41 percent of online learning students did not have an opinion on this issue. 38 percent of contact and 72 percent of online learning students would prefer to be assessed individually.

4. The problem-based learning course helped to develop analytical skills and improved communication skills by about 70 percent of contact and more than 30 percent of online learning students. Both contact and online learning students improved their job planning skills (75 percent and 63 percent, respectively). Group work skills improved for 70 percent of contact and only 10 percent of online learning students. Problem solving skills were formed for 40 percent of contact and 16 percent of online learning students.

References

1. Aleksandravičiūtė B., Liekis K. (2020). Šiuolaikinės mokymo(si) strategijos aukštosiose mokyklose: komandomis grįstas mokymas(is). *Acta Paedagogica Vilnensis*. Vol. 44, pp. 141–151.

2. Aronoff N., Stellrecht E., Lyons A. G., Zafron M. L., Glogowski M., Grabowski J., Ohtake P. J. (2017). Teaching evidencebased practice principles to prepare health professions students for an interprofessional learning experience. Journal of the Medical Library Association, 105(4).

3. Balkevičius M., Jarulė V. (2017). Probleminių situacijų sąvadas: veterinarijos felčerių probleminio mokymosi priemonė. Vilniaus kolegija. ISBN 978-609-436-047-3.

4.   Balkevičius M., Jarulė V. (2016). Veterinarijos felčerio probleminio mokymosi gidas: metodinės rekomendacijos fasilitatioriui ir besimokančiajam. Metodinis leidinys. Vilnius: Ciklonas. ISBN 978-609-436-045-9.

5.   Brazdeikis V. et al. (2020). Distance learning/education guide. Retrieved from http://www.bartkuskis.sirvintos.lm.lt/wp-content/uploads/2020/03/Nuotolinio_mokymosi_vadovas_visas_08-20.pdf.

6.   Elzainy A., Abir El Sadik A., Al Abdulmonem W. (2020). Experience of e-learning and online assessment during the COVID-19 pandemic at the College of Medicine, Qassim University. J Taibah Univ Med Sci. 15(6): 456–462.

7.   Frame T., Gryka R., Kiersma M., Todt A., Cailor S., Chen A. (2016). Student Perceptions of and Confidence in Self-Care Course Concepts Using Team-based Learning. American Journal of Pharmaceutical. Education, 80(3), 1–10.

8.   Jin J., Bridges S. M. (2014). Educational technologies in problem-based learning in health sciences education: a systematic review. J Med Internet Res 16(12):251.

9.   Kyriakoulis, K., Patelarou, A., Laliotis, A., Wan, E. C, Matalliotakis, M., Tsiou, C., & Patelarou, E. (2016). Educational strategies for teaching evidence-based practice to undergraduate health students: systematic review. Journal of Educational Evaluation for Health Professions, 13, 34.

10.   Lehane E., Warren P. L., O'Riordan C., Savage E., Drennan J., O'Tuathaigh C., Hegarty J. (2017). Research on teaching of evidence based practice in Ireland – to healthcare professionals and healthcare students. Retrieved from https://assets.gov.ie/11517/56d7868108eb45e1adc984c6b91dfed5.pdf.

11.   Lim W. K. (2012). Dysfunctional problem-based learning curricula: resolving the problem. BMC Med Educ 12:89.

12.   Nokes-Malach T., Richey E., Gadgil S. (2015). When is better to learn together? Insights from research on collaborative learning. Educ Psychol Rev 27, 645–656.

13.   Reich S., Simon J. F., Ruedinger D., Shortall A., Wichmann M., Frankenberger R. (2007). Evaluation of two different teaching concepts in dentistry using computer technology. Adv Health Sci Educ Theory Pract 12(3):321–329.

14.   Savin-Baden M., Wilkie K. (2004). Challenging Research in Problem-based Society for Research in Higher Education and Open University Press.

15.   Šakalytė D., Indrašienė V. (2021). Mokymo(si) strategijų ir metodų taikymas slaugos studijų studentams mokant įrodymais grįstos praktikos. Applying teaching strategies and methods to teaching evidence-based practice to nursing students. Social inquiry into well-being. 19(2), p. 37–52.

16.   Tudor Car L., Myint Kyaw B., Dunleavy G., Smart A. N., Semwal M., Rotgans J., Low-Beer N., Campbell J. (2019). Digital Problem-Based Learning in Health Professions: Systematic Review and Meta-Analysis by the Digital Health Education Collaboration. J Med Internet Res 21(2):e12945.

17.   Verstegen D. M. L., de Jong N., van Berlo J., Camp A., Könings K. D., van Merriënboer J. J. G., et al. (2016). How e-Learning Can Support PBL Groups: A Literature Review. In: Bridges S, Chan LK, Hmelo-Silver CE, editors. Educational Technologies in Medical and Health Sciences Education. Cham: Springer International Publishing; 2016:9-33.

18.   Wilder S. (2014). Impact of problem-based learning on academic achievement in high school: a systematic review. Educational Review 67(4):414–435.

19.   Yew E. H. J., Goh K. (2016). Problem-Based Learning: An Overview of its Process and Impact on Learning. Health Professions Education 2(2):75–79.

THE COMPARISON OF HELMINTH INFECTIONS IN PET SNAKES AMONG AMATEUR AND PROFESSIONAL SNAKE KEEPERS

Virginija Jarulė
Vilniaus kolegija / University of Applied Sciences
Lithuania

Kęstutis Radziulis
Vilniaus kolegija / University of Applied Sciences
Lithuania

Marius Urbanavičius
Veterinary surgeon

Annotation
The aim of this article is to find out the prevalence of snake helminthiasis among private amateur keepers and professional snake keepers. Untreated animals are vectors of infection, and when ingested, helminths damage the digestive system, weaken the immune system, impair the absorption of nutrients, and the toxins they release, poison the body. As there is still a lack of readily available information on the breeding and care of exotic animals, one of the most common diseases of pet snakes is compared – helminthiasis among professional and amateur snake keepers.

Keywords: pet snakes, helminthic infections, coprological analysis, sedimentation method.

Introduction

Reptiles have become increasingly common domestic pets. Keeping exotic snakes as pets is becoming more and more popular every year (Vergles Rataj et all., 2014) not only in foreign countries, but also in Lithuania. There are enough forums and websites for exotic snake lovers on the Internet, which are actively involved in various health and housing issues, looking for common solutions.

The growing popularity of exotic animals has a significant impact on the interest of veterinarians in the diseases, treatment and prevention of these animals. Although this process is moving forward, it must be acknowledged that it is slow enough. Information is still lacking not only for animal keepers but also for veterinarians. As the number of exotic snakes increases, so does the number of sick snakes, so snake keepers should have more knowledge about the most common diseases in their pets. Veterinarians and the media do not carry out educational activities that would benefit current and future snake keepers. More information would significantly reduce the incidence of not only helminthiasis but also other diseases in snakes.

The infestation with parasites plays an important role. Reptiles may carry diseases, which can be spread to other animals, other animal species and even to humans (Dovč et all., 2004).

Relevance of the research. Helminthoses of exotic snakes are dangerous not only to snakes but also to other animals and their keepers. Infection of snakes with helminths is relevant not only for pet owners who keep one or more snake, but also for professional keepers, such as nature centers, zoos. Analyzing snake helminthiasis and its incidence inevitably raises the question of what influences helminth infestation and what could be done to improve the current situation.

Research object: pet snakes helminthosis.

Aim of the research: to identify the species of parasites that infected clinically healthy pet snakes at professional and amateur snake keepers.

Objectives of the research:

1. To compare the helminthic infectious in pet snakes between professional (zoos, natural centers, etc.) and amateur snake keepers.

2. To identify the species of parasites that infected clinically healthy pet snakes.

Research methods. Data of monitoring, results of coprological research.

Literature review

Exotic reptiles held by people in their homes are often infected with internal parasites (Ras-Norynska & Sokol, 2015) and some of them can infect humans (Vergles Rataj et all., 2011). A healthy reptile has a number of pathogens, all kept in check by a healthy immune system and the beneficial gut flora. When a reptile is highly stressed or under prolonged moderate to severe stress, the immune system falters. In cases of improper environmental temperatures, starvation, or prolonged dehydration, the beneficial gut flora die off and organisms benign in small numbers gain ascendancy and start causing problems (Vergles Rataj et al., 2011).

Pet shop animals were more likely to be infected with endoparasites, whereas ectoparasites were more prevalent in household animals. Cervone et all. (2016) study confirm that pathogenic and potentially zoonotic parasites are common among pet reptiles in Italy and highlight the role of veterinarians in educating the public regarding the need to control pet reptile parasitic diseases and prevent the introduction of exotic reptile parasitic species.

Insufficient control of animal origin and health status causes a risk for introduction of various diseases, including parasitoses. Parasitic infections are often chronic and in optimal habitat and maintenance conditions do not give clear clinical symptoms. In contrast, the stress of transport, inadequate microclimate in the terraria, concentration of animals or improper nutrition, can supress the immune system and lead to clinical form of parasitic diseases. Especially relating to internal parasites, which in nature live in a cohabitation with their host (Vergles Rataj et al., 2011).

According to Jorge et al. (2013) single coproscopical examination is not fully reliable, because only about 36% of the reptilian faecal samples showed the presence of parasites that were then found in postmortem examination. Nevertheless, parasitological examination of faeces is non-invasive and easy to perform. It should be performed especially in all reptiles freshly introduced to the terrarium, during the quarantine period, even if the animals do not show any clinical symptoms (Ras-Norynska & Sokol, 2015).

In European countries, the prophylactic use of anthelmintics is common in small animals, while in the United States, coprological tests are performed before anthelmintics administration to make sure that treatment is appropriate. Frequent use of anthelmintics may lead to drug resistance, for example, the use of fenbendazole has already raised concerns regarding possible toxic effects, the development of resistance and radiomimetic effects in rabbits, birds, reptiles and farm animals (Machin, 2015).

However, by practicing good sanitation and personal hygiene, and keeping snakes, lizards, chameleons and turtles out of the food preparation areas, it is possible to minimize the risk. The presence of different endoparasites have an important role on the health status of reptiles and on the development of other diseases (Satour & Deweir, 2018).

Methodology

The study was conducted in 2020-2021 among Lithuania snake keepers. Data of helminthiasis of exotic snakes were collected by interviewing exotic snake keepers and conducting coprological studies. Coprological samples of exotic snakes, collected from amateur and professional keepers were divided into three groups – snakes, grass-snakes, pythons. The infection of helminths in exotic snakes kept by professional keepers (zoos, natural centers) and private amateur growers was compared.

Coprological studies were performed in the College Laboratory. During the study period, 36 samples from private snake keepers and 25 samples from professional snake keepers (zoos, natural centers) were analyzed.

The feces used in the study were collected in sealed, disposable containers for the storage of feces. The collected snake feces were stored in a refrigerator at +3-5 °C until analysis. The coprological study was performed using the sedimentation method.

According to Wolf et all. (2014) for examination of reptile faeces two methods should be used – native smear and flotation. The aim of this study was not to identify protozoa and therefore the native smear test has not been applied. As sedimentation and flotation studies did not show significant differences in previous studies, the sedimentation method was chosen.

Sedimentation techniques

Material: scales, microscope, methylene blue 1 percent, water, strainer (with 0,5 mm mesh), 2 glass flasks, conical cup, spatula.

Procedure: weigh 10 grams of fresh faeces and mix with 250 ml of water. Strain through a grid into a conical cup and leave to stand for 10 to 30 minutes until a large precipitate settles. Drain the water, re-add 250 ml of water to the precipitate and mix. After 10-30 minutes, the water is drained.

Add 100 ml of water to the precipitate and add 5 drops of 1% methylene blue solution. After 5 minutes the water is drained and the precipitate is examined under a microscope at 40 x.

Results and Discussion

Reptiles tested in the study did not show any specific clinical symptoms for parasitic diseases, although more than 65 percent of the samples tested were positive. Infection with exotic snakes kept by private keepers-amateurs averaged almost 93 percent, professional growers (average of all three groups – snakes, grass-snakes and phytons) – 38 percent (Fig. 1).

Papini et al. (2011) states that approx. 57% of captive-bred reptiles are infected with parasites. According to A. M. Zajac & G. A. Conboy (2012), reptile parasite detection depends on the collection of the correct specimens, the number of specimens submitted, fixation, processing methods as well as diagnostic tests to be used, and the examination of personnel who are well trained in the identification of organisms. It should be noted, that these methods were developed for examination of humans and domestic animals (i.e. mostly mammals) parasites and that reptile faeces show some differences compared to other domestic animals, like the quantity available for examination (generally small) or the faecal composition (presence of urates, food artifacts or soil when samples are collected from terraria) (Wolf et all., 2014). Another recently established method (FLOTAC) has been shown to be a sensitive technique for diagnosis of parasitic infections in reptiles (Rinaldi et al., 2012) but requires a specially developed apparatus.
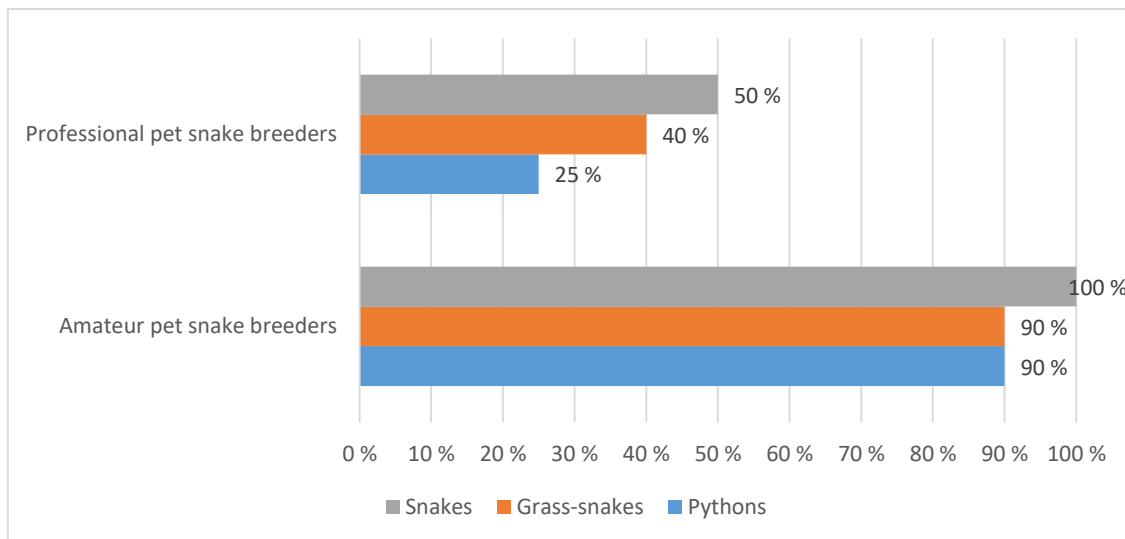

Fig. 1. Infection of pet snakes with helminths at private and professional snake keepers

Despite the fact that professional snake keepers give anthelmintics to exotic snakes once every six months, the infection rate is 38 percent (average of all three groups – snakes, grass-snakes and phytons). Helminths were found in 40 percent grass-snakes, 50 percent snakes and 25 percent pythons. This relatively high level of infection may be due to the fact that the anthelmintics were administered to these snakes only once and no re-dehelmentation was performed after two weeks. According to B. Ballard & R. Cheek (2003), if a large infestation of parasites is found, an animal such as python should be treated at least three times every two weeks. However, if the dose of the drug is strong enough and the invasion is not very high, a single dose of the drug may be sufficient. The eggs may come from the eaten rodents and are treated as pseudoparasites. It is recommended to repeat the faecal examination after a few days to rule out infection of the snake (Ras-Norynska & Sokol, 2015). Also, the litter which is used might be one of the reasons why there is a relatively large invasion of helminths with professional snake keepers, despite anthelmintics given every 6 months. Here, outdoor gravel is most commonly used as litter for snakes, and despite being heated, some helminth eggs may remain in it.

A survey of private snake keepers-amateurs revealed that only 7 percent private snake keepers have given anthelmintic drugs and only 6 percent they are given regularly every six months. This is also reflected in the research, as even 93 percent exotic snakes kept by private snake keepers are infected with helminths.
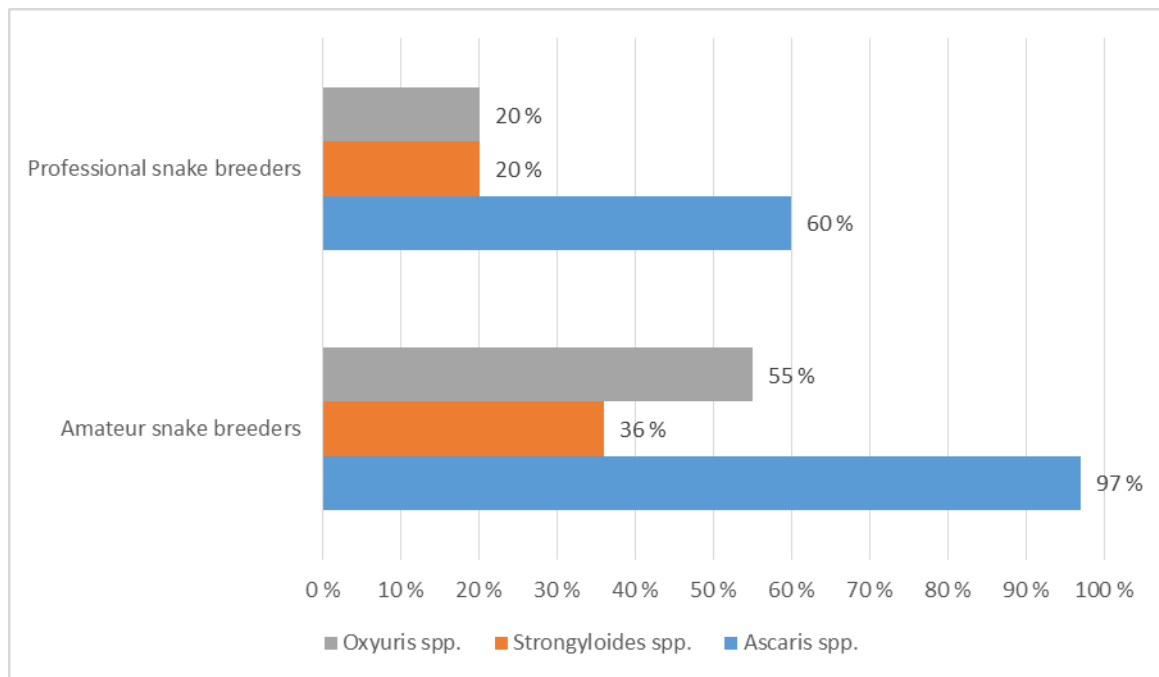
Fig. 2. Helminth species in snakes kept by amateur and professional keepers

Coprological studies of exotic snakes revealed 3 species of nematodes. *Ascaris spp.*, *Oxyuris spp.* and *Strongyloides spp.* was mostly detected in both groups of snakes (professional and amateur) with 60 percent and 97 percent, to a lesser extent *Oxyuris spp.*, 20 percent and 55 percent respectively and the least *Strongyloides spp.*, 20 percent and 36 percent respectively. However, only one species of helminth eggs or larvae (*Ascarids spp.* or *Strongyloides spp.* or *Oxyuris spp.*) was found in the faecal sample of one animal in professional keepers, and either only *Ascarids spp.* or two species of nematodes were found in one snake faecal sample of private keepers (*Ascaris spp.* and *Strongyloides spp.* or *Ascaris spp.* and *Oxyuris spp.*).

According to A. Vergles Rataj et all. (2014) data, in many of reptiles two or more different species of parasites were found. In two cases four different parasitic species were identified: in Ball Python *Strongylid* eggs, *Ascaridae*, *Capillaria spp.* and *Pentastomida* (*Porocephalus crotali*), and in Spotted Desert Racer *Strongylid* eggs, *Acanthocephala*, *Cyclospora spp.* and eggs and adults of *Porocephalus crotali*. By W. Beck & N. Pantchev (2012), *Ascarid* nematoda is one of the most important pathogens for snakes and infestation can be fatal. By A. Vergles Rataj et al. (2014), the most frequent parasites found in snakes were *Strongylid* nematoda. *Ascarid* eggs, *Oxyurid* eggs, *Strongyloides spp.*, *Capillaria spp.*, *Trematoda*, *Acanthocephala*, *Trichomonadidae*, *Cryptosporidium spp.*, *Cyclospora spp.* and *Nyctotherus spp.* were also detected. Similar parasite invasions are described in the literature (Mader, 1996; Klingerberg, 1993).

According to Rapševičiūtė (2021), coprological examinations should be performed in both clinically healthy reptiles and reptiles with clinical signs of disease. The most accurate results are obtained using two coprological test methods – native smear and flotation.

Ascaridia spp. and *Strongylus spp.* infections result in nonspecific gastrointestinal signs such as haemorrhagic ulcers and maldigestion, that may lead to general debility. Parasitic diseases combined with stress and poor husbandry conditions (e.g. malnutrition or low temperature in the terrarium) may even lead to death of the reptile (Ras-Norynska & Sokol, 2015).

Conclusions

- According to professional snake keepers, the total infectivity of snakes reaches 38 percent. Helmintas were found in 40 percent grass-snakes, 50 percent snakes and 25 percent pythons.
- Only 7 percent private snake keepers have given anthelmintic drugs to their pets and only 6 percent respondents give anthelmintics regularly. This is also reflected in research, as even 93 percent exotic snakes kept by private snake keepers are infected with helminths.
- *Ascaris spp.* was mostly detected in both professional and amateur snake keepers, with 60 percent and 97 percent, a bit less extent *Oxyuris spp.*, respectively 20 percent and 55

percent and at least *Strongyloides spp.*, respectively 20 percent and 36 percent. However, only one species of helminth egg or larvae was found in the faecal sample of one animal by professional keepers and of private keepers was found only ascarids or two species of nematodes (*Ascaris spp.* and *Strongyloides spp.* or *Ascaris spp.* and *Oxyuris spp.*) were found in one faecal sample of private keepers.

References
1. Ballard B., Cheek R. (2003). Exotic Animal Medicine for the Veterinary Technician. Iowa State Press. ISBN 0-8138-1928-8. P. 379. USA.

2. Beck W., Pantchev N. (2012). Praktische Parasitologie bei Heimtieren. Kleinsäuger - Vögel - Reptilien – Bienen. 978-3-89993-088-7 (ISBN).

3. Cervone M., Fichi G., Lami A., Lanza A., Damiani G. M., Perrucci S. (2016). Internal and External Parasitic Infections of Pet Reptiles in Italy. Journal of Herpetological Medicine and Surgery 26(3-4), 122-130.

4. Dovč A., Vergles Rataj A., Lindtner-Knific R., Zorman-Rojs O., Krapež U., Ocepek M., Cigler B., Jerič B., Zadravec M. (2004). Proceedings of the 1st Croatian - Slovenian symposium about exotic and wild animals. Zagreb, Croatia. Croatian Veterinary Society and Slovenian Veterinary Association. Health status of wild varanus captured from nature pp. 21–23.

5. Jorge F., Carretero M. A., Roca V., Puulin R., Perera A. (2013). What you get is what they have? Detectability of intestinal parasites in reptiles using faeces. Parasitology Research 112: 4001-4007.

6. Klingenberg R. J. (1993). Understanding reptile parasites: a basic manual for herpetoculturists & veterinarians. Lakeside, CA, USA.

7. Machin R. A. (2015). Common gastrointestinal parasites in reptiles. In practice. 37:469–475.

8. Mader D. R. (1996). Reptile medicine and surgery. Philadelphia.

9. Papini R., Manetti C., Manciani F. (2011).Coprological survey in pet reptiles in Italy. Veterinary Record 169:207-210.

10. Rapševičiūtė T. (2021). Keeping and care of reptiles, parasitic diseases and their prevention. Veterinary Medicine Master's Thesis. Thesis supervisor Judita Žymantienė. Kaunas. Lithuanian University of Health Sciences Veterinary Academy.

11. Ras-Norynska M., Sokol R. (2015). Internal parasites of reptiles. Annals of Parasitology 61(2), 115-117.

12. Rinaldi L., Mihalca A. D., Cirillo R., Maurelli M. P., Montesano M., Capasso M., Cringoli G. (2012). FLOTAC can detect parasitic and pseudoparasitic elements in reptiles. Exp Parasitol. 130: 282-284. 10.1016.

13. Satour N. S., and Deweir A. W. (2018). Some internal parasites of reptiles in Alexandria province, Egypt. Egyptian Veterinary Medical Society of Parasitology Journal. 14:98-114.

14. Vergles Rataj A., Lindtner – Knific R., Vlahovic K., Mavri U., Wolf D., Globokar Vrhovec M., Failing M., Rossier Ch., Carlos H., Pantchev N. Diagnosis of gastrointestinal parasites in reptiles: comparison of two coprological methods. Acta Veterinaria Scandinavica. 2014. 56:44.

15. Vergles Rataj A., Lindtner-Knific R., Vlahović K., Marvi U., Dovč A. (2011). Parasites in pet Reptiles. Acta Veterinaria Scandinavica 53: 33-54.

16. Wolf D., Globokar Vrhovec M., Failing K., Rossier Ch., Carlos H., Pantchev N. (2014). Diagnosis of gastrointestinal parasites in reptiles: comparison of two coprological methods. Acta Veterinaria Scandinavica. 56, Article number: 44.

17. Zajac A. M., Conboy G. A. (2012). Fecal Examination for the Diagnosis of Parasitism. Veterinary Clinical Parasitology. Wiley-Blackwell, Chichester, 3-164. 8.

EXPERIMENTAL RESEARCH OF SERVICE SYSTEM

Liudvikas Kaklauskas
Šiauliai State University off Applied Sciences
Lithuania

Annotation
Most of the modern service systems have different performance channels. Most of them are ineffective because queries are distributed to channels in random order. In order to use them efficiently it is necessary to choose the right strategy for query distribution. In this article we take experimental research with service system having two different performance channels. The study found, that service system efficiency belongs from flow intensity and from detention buffer length.

Key words: service system, different performance channels, buffer, query, heterogeneous network.

Introduction

Service systems are widely used in business and technology. Efficient service systems are necessary in order to save resources as well as to serve as much clients as possible. Currently there are many various service strategies which have their own pros and cons. The known service strategies are suited for systems with equal performance channels, however, in practice service systems have different performance channels (Erlong, 1909, Sakalauskas, 2000, Iversen, 2011). For instance, at the shop every cashier's efficiency depends on her experience in this field, therefore her service speed can be several times higher than the new cashier who is working for several days. The similar situation is encountered in computers where work is done by CPU and GPU. Thus their capacity may differ up to 100 times, therefore it is necessary to allocate them the work optimally (Bilel, etc., 2012, Hetherington, etc., 2012).

However the systems with different performance channels are not discussed sufficiently in scientific literature as in this case the received mathematical patterns are greatly difficult (Efrosinin, Rykov, 2008, Rykov, Efrosinin, 2009). The well-known works by E. R. Larsen (Sankaranarayanan, Larsen, van Ackere, Delgado, 2010) as well as Rybinovitch (Rubinovitch, 1985, Mokaddis, Matta, El Genaidy, 1998) discussed the service systems with two different performance channels, however not many results are provided and without clear grounding.

When the capacities of processors vary with little difference, then the service disciplinary might be the first to come the first to be served, and the query goes straight to the free channel or waits in line until another channel clears up. It is noted that under high capacity ratio this disciplinary slows the system work (Rykov, Efrosinin, 2008). In case of high ratio, it appears that it is useful to install detention buffer as sometimes it is more efficient to wait until the high speed channel gets free eventhough the inefficient channel was free. Systems with detention buffers were discussed in works, as well as some of the trials have been received in Rubinovicius's work. Recently the relevance of research of these systems has been increased by creating multiprocessor calculation systems, combining CPU (A Central Processing Unit) and GPU (A Graphics Processing Unit) processors (Hetherington, & etc., 2012, Kadjo, & etc., 2015), by creating combined service systems of high and low capacity networks (Rykov, Efrosinin, 2004, Yue, &etc., 2009, Efrosinin, Sztrik, 2011). As their capacity may vary up to 100 times therefore there is an actual task to discuss systems in which the ratio of capacity of used processors is increasing and we can apply respective asymptotic extensions. In the scientific literature about the systems with two different performance channels mostly analyzes theoretical side of problem, but no used experimental research by simulation. This work it is discussed experimental research of service system having two different performance channels.

1. Two-channel service systems characteristics

A discussed service system consists of two different performance channels as well as one detention buffer. Assuming that the time length between two adjacent queries is falling within the discussed service systems, allocated under the Puason's Law with parameter λ and the length of service is allocated also under this Law with parameters μ_1 and μ_2 (faster channel and slower channel). Assuming that the queries are served in sequence, i.e. first came – first served (Gelenbe, Pujjole, 1999, Xiaolong, Geyong, 2009).

If the query after being released into the system finds a free performance channel, it is served immediately; otherwise it goes to detention buffer of k length where it waits until the

efficient channels gets free. One query is served by one channel. If all places in detention buffer are occupied, the query rejects the service of performance channel and transfers to the slow channel. If the slow channel is occupied as well, the application waits in m row of finite length. If all places are occupied, the query rejects and not served. This strategy is suitable only when the coefficient of flow volume $\rho = \frac{\lambda}{\mu_1 + \mu_2}$ is lower than 1, because in case of higher intensity it is not efficient to keep free channels even though they are slow.

In the service system with two different performance channels we use denotes and formulas discussed in L. Kaklauskas, L. Sakalauskas and V. Denisovas article (Kaklauskas, , & etc., 2019).

2. Experimental research of service system

With the local and global development of computer networks, there is an increase of mixed (several of diverse forms) of heterogeneous network, which connect many sub-networks of capacity, supporting different standards, protocols as well as velocities of network. *HetNet* definition is used in modern heterogeneous wireless computer networks using various types of network nodes for description. Compatibility problems of heterogeneous networks are solved by offering specialized data maintenance solutions (Chang ant etc., 2015, Yang, Chawla and etc., 2012, Qi and etc., 2012), evaluating their combining cases (Shi, 2017), analyzing errors, links (Zhang and etc., 2013, Sajadmanesh and etc., 2016, Yang, Kung, and etc., 2013).

Our solution will help to choose optimal network node detention buffer, by combining networks of different capacity. Absolute majority of companies in local network of *Ethernet* (IEEE 802.3) also realize the wireless sub-network ensuring the accessibility of service for mobile users. Using 802.11n (802.11n-2009 – IEEE Standard for Information technology – Local and Metropolitan area network) standard WLAN (Wireless Local Area Network, IEE 802.11) network node, usually its technical possibilities guarantee 300 Mbps one-channel speed. In the network of company's *Gigabit Ethernet* it is ensured with up to 1000 Mbps channel speed. Upon the arrival of queries through these channels into company's network server, the efficiency ratio of served channels *r=3.3*. For the optimal work of this node it is sufficient to have buffer of 2-7 applications. If *802.11g WLAN* node is used, then *r=18.5*, and buffer 14-16 applications.

Pattern of computer network node with two different performance channels was used for service system research. Modeled system uses the disciplinary of queue service *FIFO taildrop* (Nzouonta, Ott, Borcea, 2009). It is considered that in the primary state both service system channels and queue are free (t=0), i.e. system is prepared to service the received application immediately. By imitating network node work, length of sequence of moments between the appearance of packaged in the node were generated $\tau_0, \tau_1, \dots \tau_n$ and length sequence of the package service $x_0, x_1, \dots x_n$. Using these sequences, the characteristics of package service are being calculated in accordance with the distributions and services procedures of the sequences'elements. Modeled network flow is generalized stochastically bounded burstiness *gSBB* (hereinafter *gSBB*). This flow for all $t \geq 0$ as well as all $x \geq 0$ satisfy the inequality $P\{\hat{A}(t, \rho) > x\} \leq f(x)$, when ρ is the upper limit of the flow, *f* – coverage function which is not increasing and $f(x) \geq 0$ for all $x \geq 0$, $A(0, t)$ – incoming flow, satisfying the inequality $A(0, t) \ll \langle f, \rho \rangle$ (Jiang, Yin, Liu, Jiang 2009). It is shown that if *gSBB* network flow demonstrates stationary and ergodicity peculiarities, then $P\{\hat{A}(t, \rho) > x\}$ in any moment of times has the upper limit in constant section of queue length, i.e. $P\{\hat{A}(\infty, \rho) > x\}$ in virtual one channel system with constant ρ. Here $\hat{A}(\infty, \rho)$ indicates $\hat{A}(t, \rho)$, when $t \to \infty$ (Jiang, Yin, Liu, Jiang 2009). Length of generated network flow packages is variable and satisfying the requirements of *Ethernet* standard.

(Jiang, Yin, Liu, Jiang 2009) proofed that according to *gSBB* singularity process is modeled according the formula:

$$f^{self-similar}(x) = C_\alpha \left(\frac{\rho - m}{\delta}\right), \qquad \text{when the satisfied inequality is}$$

$P\{\hat{A}(t, \rho) > x\} \leq f^{self-similar}(x)$.

Here C_α and *m* are calculated as parameters of $S_\alpha(\beta, \sigma, \mu)$ and *x*. According to *gSBB* pattern, Puason's flow is modeled using the formula:

$$f^{Poisson}(x) = 1 - (1 - \eta) \cdot \sum_{i=0}^{k} \left[\frac{[\eta(i-k)]^i}{i!} e^{-\eta(i-k)}\right], \text{ when the satisfied inequality is}$$

$P\{\hat{A}(t, \rho) > x\} \leq f^{Poison}(x)$. Here $\eta = \frac{\lambda S}{\rho}$ and $k = \frac{x}{S}$, where $\underline{S}$ is the average package length.
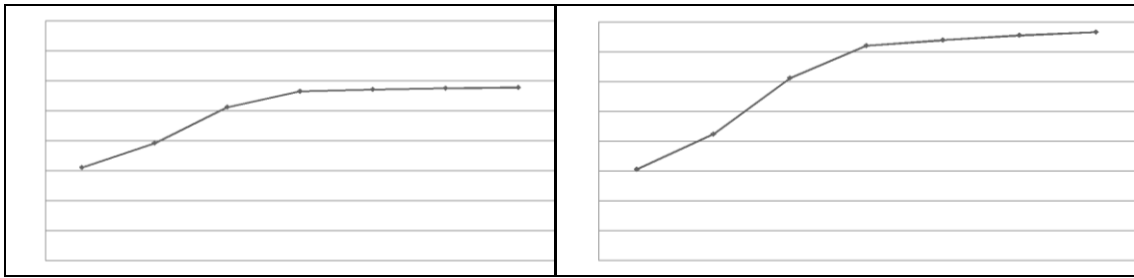
Fig. Average number of queries in the system changing the length of buffer, when *r=5* (left picture) and *r=15 (right picture)*.

The received findings of simulation of system with one efficient (fast) and one inefficient channel (slow) confirmed that 5-10 application buffer is enough for 802.11n and *Gigabit Ethernet* channels (*r=3.3*). When 802.11 n and *Gigabit Ethernet* channels (*r=18.5*) are used then 10-15 application buffer is enough for optimal system work.

3. Conclusions

1. When the flow intensity ρ is close to zero, optimal buffer size varies linearly relative to *r*
$$K_{opt} = 1,12 \cdot r - 2.$$

2. When the flow intensity ρ is close to 1, optimal buffer size is calculated using formula
$$K_{opt} = 1,12 \cdot r^2 + o(r^2).$$

3. In case of high capacity of channels to ratio r, numbers of application becomes the same as using one-channel system, therefore in which case it is recommended to refuse the second inefficient channel.

References

1. Bilel, B. R., Navid, N., & Bouksiaa, M. S. M. (2012, October). Hybrid cpu-gpu distributed framework for large scale mobile networks simulation. In Proceedings of the 2012 IEEE/ACM 16th International Symposium on Distributed Simulation and Real Time Applications (pp. 44-53). IEEE Computer Society.

2. Chang, S., Han, W., Tang, J., Qi, G. J., Aggarwal, C. C., & Huang, T. S. (2015, August). Heterogeneous network embedding via deep architectures. In Proceedings of the 21th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (pp. 119-128). ACM.

3. Efrosinin, D. V., & Rykov, V. V. E. (2008). On performance characteristics for queueing systems with heterogeneous servers. Automation and Remote Control, 69(1), 61-75.

4. Efrosinin, D., & Sztrik, J. (2011). Performance analysis of a two-server heterogeneous retrial queue with threshold policy. Quality Technology & Quantitative Management, 8(3), 211-236.

5. Erlong, A. K. (1909). The theory of probabilities and telephone conversations. Nyt Tidsskrift Mat. Vol. 20, pp. 33-39.

6. Gelenbe, E., Pujjole G. (1999). Introduction to queuing networks, second edition. John Willey & Sons, pp. 258

7. Hetherington, T. H., Rogers, T. G., Hsu, L., O'Connor, M., & Aamodt, T. M. (2012, April). Characterizing and evaluating a key-value store application on heterogeneous CPU-GPU systems. In Performance Analysis of Systems and Software (ISPASS), 2012 IEEE International Symposium on (pp. 88-98). IEEE.

8. Iversen, V. B. (2011). Teletrafic Engineering And Network Planning. Technical University of Denmark, pp. 567.

9. Kadjo, D., Ayoub, R., Kishinevsky, M., & Gratz, P. V. (2015, June). A control-theoretic approach for energy efficient CPU-GPU subsystem in mobile platforms. In Proceedings of the 52nd Annual Design Automation Conference (p. 62). ACM.

10. Kaklauskas, L., Sakalauskas, L., & Denisovas, V. (2019). Stalling for solving slow server problem. RAIRO-Operations Research, 53(4), 1097-1107.

11. Mokaddis, G. S., Matta, C. H., & El Genaidy, M. M. (1998). On Poisson queue with three heterogeneous servers. International journal of information and management sciences, 9(4), 53-60.

12. Qi, G. J., Aggarwal, C., & Huang, T. (2012, April). Transfer learning of distance metrics by cross-domain metric sampling across heterogeneous spaces. In Proceedings of the 2012 SIAM International Conference on Data Mining (pp. 528-539). Society for Industrial and Applied Mathematics.

13. Rubinovitch, M. (1985). The slow server problem: a queue with stalling. Journal of Applied Probability, 22(04), 879-892.

14. Rykov, V. V. E., & Efrosinin, D. V. (2009). On the slow server problem. Automation and Remote Control, 70(12), 2013-2023.

15. Rykov, V., & Efrosinin, D. (2004). Optimal control of queueing systems with heterogeneous servers. Queueing Systems, 46(3), 389-407.

16. Sajadmanesh, S., Rabiee, H. R., & Khodadadi, A. (2016, August). Predicting anchor links between heterogeneous social networks. In Advances in Social Networks Analysis and Mining (ASONAM), 2016 IEEE/ACM International Conference on (pp. 158-163). IEEE.

17. Sakalauskas, L. (2000). Masinio aptarnavimo teorija. VGTU, „Technika", pp. 156.

18. Sankaranarayanan, K., Larsen, E. R., van Ackere, A., & Delgado, C. A. (2010, December). Genetic algorithm based optimization of an agent based queuing system. In Industrial Engineering and Engineering Management (IEEM), 2010 IEEE International Conference on (pp. 1344-1348). IEEE.

19. Shi, C., Li, Y., Zhang, J., Sun, Y., & Philip, S. Y. (2017). A survey of heterogeneous information network analysis. IEEE Transactions on Knowledge and Data Engineering, 29(1), 17-37.

20. Xiaolong, J., Geyong M. (2009). Modelling and Analysis of Priority Queuing Systems with Multi-Class Self-Similar Network Traffic: A Novel and Efficient Queue-Decomposition Approach. IEEE Transactions on Communications; vol. 57, No. 5, pp. 1444-1452

21. Yang, C. L., Kung, P. H., Li, C. T., Chen, C. A., & Lin, S. D. (2013, December). Sampling Heterogeneous Networks. In Data Mining (ICDM), 2013 IEEE 13th International Conference on (pp. 1247-1252). IEEE.

22. Yang, Y., Chawla, N., Sun, Y., & Hani, J. (2012, December). Predicting links in multi-relational and heterogeneous networks. In Data Mining (ICDM), 2012 IEEE 12th International Conference on (pp. 755-764). IEEE.

23. Yue, D., Yue, W., Yu, J., & Tian, R. (2009). A heterogeneous two-server queuing system with balking and server breakdowns. In Eight International Symposium on Operations Research and its Applications (ISORA'09). Zhangjiajie, Chaina.

24. Zhang, W., Wang, S., Yang, Y., & Wang, Q. (2013, November). Heterogeneous network analysis of developer contribution in bug repositories. In Cloud and Service Computing (CSC), 2013 International Conference on (pp. 98-105). IEEE.

PRIMARY SCHOOL STUDENTS' CREATIVE THINKING SKILLS IN MATHEMATICS

Renata Kondratavičienė
University of Applied Sciencies / Vilniaus kolegija; Vytautas Magnus University Education Academy
Lithuania

Viktorija Sičiūnienė
Vytautas Magnus University
Lithuania

Annotation

To develop creative thinking skills while learning mathematics in primary school, it is important to have a description of creative thinking skills and an instrument to measure these skills. The article presents: 1) a description of creative thinking skills, 2) a tool developed by the authors, empirically tested, and substantiated for measuring creative thinking skills (test), 3) the results of research analysis by groups of creative thinking skills (exploration and ideas generation; formulating questions and finding solutions) and gender.

Keywords: creative thinking skills, mathematics, primary school.

Introduction

Relevance of the topic. Examining both global (European Commission, 2011; OECD, 2019; World Economic Forum, 2016) and National Education Regulations documents (Good School Concept, 2015; State Progress Strategy „Lietuva 2030", 2012) noted that it is important to empower students to creatively solve problems and think critically. It is agreed that higher-level thinking skills include the skills to adapt to a rapidly changing world, to solve constantly emerging new problems, to contribute to the creation of innovations.

The discussion on the development of higher-level thinking skills in Lithuania started in 2003-2012, analysing the results of national and international studies of students' achievements. The results of the data analysis from the Trends in International Mathematics and Science Research TIMSS 2015 report (Dukynaitė, Skripkienė, and Stundža, 2016, p. 17) show that Lithuania's 4th grade mathematics performance has been steadily improving since 2007 and, according to Trends in International Mathematics and Science Research TIMSS 2019 report (Dukynaitė and Buinevičiūtė, 2020), became statistically significantly higher than the international average. However, the biggest positive change in achievements is observed in the field of mathematics knowledge application, while changes in mathematical knowledge and mathematical thinking are limited. Curriculum specialists, researchers of student achievement, have repeatedly discussed the components of higher-level thinking skills. What are the links between creative thinking skills and students' mathematics achievements?

The scientific depth of the problem. Unfortunately, today we have relatively little data on the thinking skills of Lithuanian students. In national studies on learning outcomes, there were relatively few questions for a higher level of thinking assessment. The Lithuanian Primary Education Program (2008) the thinking skills are described quite generally, and Lithuanian teachers do not yet have descriptions of thinking skills and official examples of assessment of higher-level thinking skills.

Regarding the development of higher-level thinking skills, critical and creative thinking skills are mentioned (OECD, 2019; Krulik and Rudnick, 1993; Plubsiri and Chaiyasang, 2020) (Fig. 1). In the article we will focus on the skills of creative thinking. Defining the latter as a new and appropriate product/solution or idea.
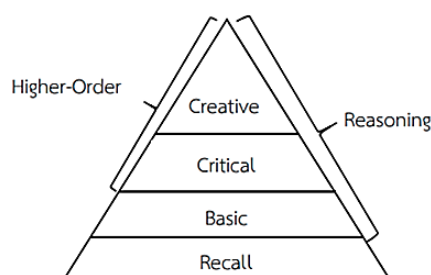

Fig. 1. Hierarchy of Thinking (Krulik and Runick, 1993, cit. by Plubsiri and Chaiyasang, 2020)

Research on creative thinking skills is also available in Lithuania. Links of creativity with intelligence and talents have been explored (Grakauskaitė-Karkockienė, 2002; Almonaitienė, 2006; Narkevičienė, 2007; Petrulytė, 2001, etc.). Intelligence in these authors' works is associated with the ability to solve problems or adapt, the ability to better understand and use abstractions, and the ability to learn. It is noted that individuals with low intelligence are rarely characterised by creativity, but high intelligence is not necessarily an indicator of creativity. Petrulytė, Beresnivičienė and Samašonok (2004) have proposed a full list of general skills of creative thinking: create new combinations of words, objects, colours, stories; to discern and create a wide range of combinations; identify missing items; create more complex combinations by drawing or constructing; see combinations of characters, numbers of objects; use language skills to create new combinations of words; summarise titles, drawings.

It is claimed that creative thinking skills can be successfully developed if students are involved in active thinking activities (Balevičienė, 2016), students are given many opportunities to test and combine various research activities and learning strategies through collaboration, offer a rich set of activities that need to solve different problems of interest to students, learn to reflect and reflect on the experience gained (Rudienė, Sičiūnienė, Bareikienė, and Uinskienė, 2015).

The problems of creative thinking development opportunities through mathematics lessons are in works of Grakauskaitė-Karkockienė, Sičiūnienė, and Strolienė (2016), Vaičiūnaitė and Sičiūnienė (2014). The researchers were also interested in the experience of Lithuanian educators and attitudes towards the development of children's creative thinking (Kondratavičienė, Sičiūnienė, Grakauskaitė-Karkockienė, and Karčauskienė, 2019) studied critical and creative thinking abilities of fourth grade students in mathematics (Kondratavičienė and Sičiūnienė, 2021). It was proposed to link higher-level thinking skills to the development of logically accurate thinking (Grabauskienė and Mockaitytė-Rastenienė, 2016; Norvaiša, 2019). Attention was drawn to the importance of the application of reading strategies in developing students' higher-level thinking skills (Sičiūnienė and Toleikytė, 2017), the adaptation of verbal and visual information to the specific needs of children in solving textual challenges (Grabauskienė and Zabulionytė, 2018).

Research Methodology

Research problem. Among teachers, there is a debate about whether it is possible to develop creative thinking skills in a younger school age, especially when it comes to not only talented students. Of course, the issue of approach is very important. However, when formulating one or another approach, we need to clearly identify what is meant by showing examples of how creative thinking can be understood and interpreted at a younger school age, especially when it comes to a specific subject (in this case mathematics). Teachers do not know what creative thinking skills they should develop and how they can measure students' achievements. The concept of creative thinking skills is dynamic, changing, depending on the educational context (Beghetto, 2010; Mann, 2005). Therefore, it is important to offer the country's teachers a list of creative thinking skills when learning mathematics. It is also important to offer an instrument (test) to diagnose achievements in students' creative thinking skills.

According to the situation discussed, **the scientific problem** of the research **is** formulated: what are the components of creative thinking skills in mathematics and how to measure them? The scientific problem highlights **the research object**: primary school students' creative thinking skills and their diagnosis by teaching and learning mathematics. **The goal of the research is** to define and assess the creative thinking skills of fourth-class students by teaching and learning mathematics.

Objectives to achieve the objective of the **research**:
1. Develop a list of creative thinking skills when learning mathematics in the fourth grade.
2. Create and empirically substantiate a test to measure the creative thinking abilities of fourth-class students by teaching mathematics.
3. Discuss of fourth-class students the results of research analysis by groups of creative thinking skills and gender.

The research was based on a **modern concept of creativity.** This approach is based on the idea that everyone has creative potential, and his unfolding is not related to any field (Ivcevic and Mayer, 2006). Unlike the classical concept, this concept emphasises the social nature of creative thinking, the relationship between man and context. It is emphasised that although creative thinking can be described as a general conceptual level, the expression of

creative thinking skills differs in the subjects taught at school and depends on the general context of education (Kaufman and Beghetto, 2009).

Survey data collection methods: Analysis of scientific literature and documents, expert assessment, testing.

Methods of analysis of test data: Descriptive statistics. Kolmogorov-Smirnov test. Descriptive statistics. The data of the survey were processed using version 23 of the IBM SPSS Statistical Programmes (Statistical Package for Social Sciences). The Cronbach Alpha coefficient was calculated to verify the internal consistency of the test tasks.

Research ethics. The main ethical principles of the European Code of Conduct for Research have been respected throughout the research (ALLEA, 2019): reliability; good faith; respect for colleagues, research participants and the public; responsibility for research.

According to scientists, a person can create an original mathematical idea if he perceives the relationship between mathematical elements (Silver, 1997). This is the basis of creative thinking that comes from the subconscious, when a new way of solving the problem is suddenly discovered (Mann 2005; Mak, Mak, and Mak, 2017). Creative thinking skills include inquiring, imagining, doing, reflecting (Vincent-Lancrin et al., 2019). Sternberg (1997) emphasises the ability to systematise, to analyse and to contextualise. Treffinger, Young, Selby, and Shepardson (2002) found 120 definitions of creativity and grouped them into four groups: 1) generation of ideas, 2) deepening of ideas, 3) openness and courage to explore ideas, and 4) listening to your inner voice.

Most specialists in the manifestation of creative thinking skills in mathematics rely on Guilford (1987) works, in which the basis of creative thinking is the divergent thinking, which includes four components: smoothness, flexibility, originality and detail.

Most researchers of creative thinking skills in mathematics rely on Guilford (1987) works in which creative thinking is based on divergent thinking, comprising four components: fluency, flexibility, originality, and elaboration.

Mann (2005) proposes to add to the list of creative thinking abilities to raise questions that are difficult to answer, but it is possible to answer with good thought. Emphasis is also placed on the individual's tendency to seek new connections and ideas, to improve work and share the results obtained with others (Silver, 1997; Sriraman et al., 2011).

Based on the thoughts examined by scientists, the authors of the article compiled a possible description of creative thinking abilities while learning in the fourth grade of mathematics. It also combined the wording of the description with those mentioned in the new Lithuanian Primary Education Program's project, which was submitted for consideration on the website of the Lithuanian National Education Agency (https://www.mokykla2030.lt).

Two groups of creative thinking were distinguished: exploration and ideas generation; formulating questions and finding solutions (Table 1).

Table 1

Creative Thinking Skills in Mathematics and distribution of tasks according to skills and levels of student achievement

Group of Creative Thinking skills	Skills in Mathematics	Number of tasks (number of points)		
		Satisfactory level	Basic level	Higher level
Exploration and Ideas Generation	To find sequences, set regular patterns.	1 (1)	1 (2)	
	To re-elect possible options.		1 (2)	1 (2)
	To discover the category.	1 (1)	1 (2)	
Formulating questions and finding solutions	To come up with a question (condition, task) to solve the math problem.	1 (1)	1 (2)	
	Find links between the elements in the condition.	1 (1)		
	To propose several solutions.	1 (1)	1 (2)	1 (3)
Total:		5 (5)	6 (10)	2 (5)
number of points as a percentage		25 %	50 %	25 %

Conduct of the investigation

The empirical research was conducted in two stages:

1) Preparation and validation of a research instrument (test) to measure the critical and creative thinking skills of 4th class students in mathematics.

2) Diagnostics of 4th grade students' achievements by groups of creative thinking skills and gender.

An instrument of investigation. When selecting the tasks for the test, content topics were examined not only in Lithuanian educational content documents (Lithuanian Primary Education Program, 2008; Standardized 4th grade students Mathematics Program, 2012), but also in the International Mathematics and Science Mathematics Program TIMSS (2016). The selected tasks were related to one of the two categories of creative thinking skills: exploration and ideas generation; formulating questions and finding solutions.

Prior to the test, the tasks were piloted. The process of testing the tasks allowed to see the typical mistakes made by the students, to turn some of the tasks into a closed type to suit electronic testing in a virtual learning environment. Each task and its evaluation instructions were tested in a group of 24 students, and in evaluating and considering the results obtained, modelling the target's compliance with the desired achievement level, cooperation with 3 teachers and 2 researchers was carried out.

After considering the results of the pilot test in the expert group, it was decided to model and test the test corresponding to the following parameters: the duration of the test is 45 minutes; the test consisted of 12 tasks: 2 closed type and 11 – open type; the number of points that can be scored at 20 (50 % of the task points per competency group); according to students' achievement levels, points are distributed in the following proportions: 25 % of satisfactory, 50 % basic, 25 % higher achievement levels. Further details of the test are given in Table 1.

Research impact and organisation. The sample size (N = 404) was determined using Paniotto's formula (Kardelis, 2016). When planning the empirical research, e-mails were sent to all Lithuanian primary schools. When contacting schools, it was important that all respondents participate in the survey on a voluntary basis and have equal opportunities to participate in the empirical research. The research test was conducted by the students in a virtual learning environment in Moodle.

Students' responses to closed-ended questions were evaluated by an automatic evaluation system. In line with the recommendations (Lodico, Spaulding and Voegtle, 2013), which facilitates the reliability and validity of the research, two independent, impartial external evaluators have evaluated open-ended challenges. The results of their assessment were summarised in the Percentage Agreement. 85 % of the assessments coincided, which suggests that the evaluation results are reliable.

Research Results
Numerical characteristics of the test instrument

When all the data were collected, it appeared that the students' Average grade score was 10.59 points (53.00 %). This means that the test is suitable because it is within the range of 50 % and 75 %. A Median grade score of 11.00 (55.00 %) indicates that half of the pupils have scores below or equal to 11.00 and half of the pupils scores above or equal to 11.00. Standard deviation – 4.026 (20 %) indicates the distribution of points about the average.

The internal compatibility of all tasks in the test was verified by calculating the coefficient of Cronbach alpha. Its value (0.739) demonstrates that the test task scale is reliable as a measuring instrument to assess the identified skills.

Statistical parameters for each task indicate that the tasks tested meet the requirements of this type of research and there is a correlation between the points collected for the task and the total test points (Table 2).

Table 2

Test structure analysis results

Order No:	Name of the ability corresponding to the question	Severity index	Discrimination Index	Standard deviation
1.	To find sequences, set regular patterns.	75.50 %	31.60 %	43.06 %
2.		58.04 %	35.11 %	40.51 %
3.	To-re-elect possible options.	50.74 %	36.65 %	34.14 %
4.		38.37 %	41.60 %	38.11 %
5.	To discover the category.	69.80 %	36.31 %	45.97 %

6.		57.05 %	41.77 %	38.50 %
7.	To come up with a question (condition, task) to solve the math problem.	69.31 %	32.83 %	46.18 %
8.		35.02 %	42.44 %	33.30 %
9.	Find links between the elements in the condition.	39.60 %	33.98 %	48.97 %
10.		79.21 %	34.71 %	40.63 %
11.	To propose several solutions.	49.38 %	40.98 %	41.90 %
12.		49.34 %	37.71 %	41.70 %

Analysis of students' achievements by gender

As mentioned above, the test was decided by 404 students: 218 boys and 186 girls. The distribution of their points is shown in Figure 2.
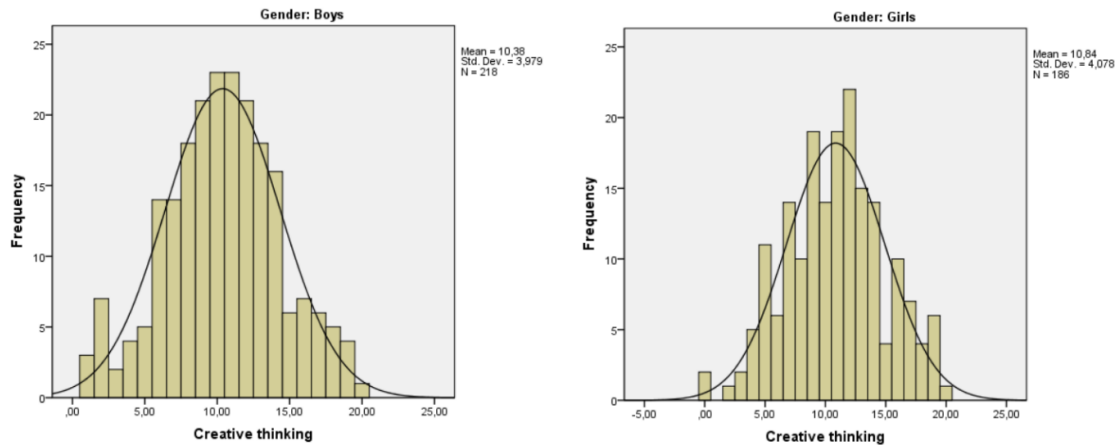

Fig. 2. Distribution of boys 'and girls' creative thinking skills test scores

The Kolmogorov-Smirnov test was used to test the hypothesis about the normality of the distribution of points collected in boys' and girls' creative thinking skills. Creative thinking skills scores for boys ($W(218) = 0.059$, $p = 0.066$) and girls ($W(186) = 0.064$, $p = 0.064$) were found to be distributed according to normal law.

When comparing the average marks for boys and girls, we see a difference in scores (see Figure 3). Hypothesis checked: H_0: an average boy's score = an average girl's score; H_1: an average boy's score ≠ an averzge girl's score. When using the student's t-test of independent groups, the difference between boys' and girls' averages of creative thinking scores was not statistically significant ($t = -1.163$, $df = 402$, $p = 0.246$).

Analysis of students' achievements by groups of creative thinking skills

The parameters of the research's creative thinking skills were studied by the following groups: Exploration and Ideas Generation; Formulating questions and finding solutions. Students were able to score 50 % of the points for each group of creative thinking skills. General information on the number of points collected and their dispersion is given in Table 3.

Table 3

Student's achievement analysis by groups of creative thinking skills

Group of Creative Thinking skills	Mean	Std. Deviation	Skewness	Kurtosis	First Quarter	Second Quarter (Median)	Third Quarter
Exploration and Ideas Generation	5.542	2.154	-0.075	-0.245	4.000	6.000	7.000
Formulating questions and finding solutions	5.050	2.410	-0.068	-0.719	3.000	5.000	7.000

The Kolmogorov-Smirnov test was used to test the hypothesis of the normality of the distribution of creative thinking skills. Data on the ability of exploration and idea generation (W(404) = 0.101, p = 0.000), formulating questions and finding solutions (W(404) = 0.105, p = 0,000) were found not to be distributed by normal law. For the Wilcoxon test for creative thinking skills, the difference in students' research and idea generation and searching for questions and solutions was statistically significant (Z = -4.642, p = 0.000, r = -0.230).

Analysis of students' achievements by groups of creative thinking skills and gender

Using the Kolmogorov-Smirnov test, the research found that boys' and girls' creative thinking skills are distributed according to normal law (p < 0.000). The Wilcoxon test showed that both boys (z = -2.889; p = 0.004), both among girls (z = -3.665; p = 0.000) there is no statistically significant difference in the ability to explore creative thinking and to generate ideas and search for questions and solutions.

Conclusions

1. The developed and tested instrument for measuring creative thinking skills (test) provides reliable information about the following creative thinking skills in mathematics for 4th grade students: to find sequences, set regular patterns; to re-elect possible options; to discover the category; to come up with a question (condition, task) to solve the math problem; to find links between the elements contained in the task condition; propose several solutions.

2. Was not find statistically significant difference between of 4th grade boys' and girls' creative thinking skills scores. 4th grade students are better able to research and generate ideas than to formulate questions and find solutions when learning math (the difference is statistically significant).

References

1. Almonaitienė, J. (2006). *Kūrybingumo ir inovacijų psichologija*. Kaunas: Technologija.

2. Balevičienė, S. (2016). Kodėl ir kaip keičiame mokinių mokymosi pasiekimų ir pažangos vertinimo sistemą bendrajame ugdyme. *Švietimo problemos analizė*, 4(147), 1-8.

3. Beghetto, R. A. (2010). Creativity in the classroom. *The Cambridge Handbook of Creativity*, 447-463. doi: 10.1017/CBO9780511763205.027.

4. Dukynaitė, R., Skripkienė, R., and Stundža, M. (2016). *Tarptautinis matematikos ir gamtos mokslu tyrimas*: Trends in International Mathematics and Science Research. TIMSS 2015. Ataskaita. Gamtos mokslai 4 kl. Vilnius: Nacionalinis egzaminų centras.

5. Dukynaitė, R. and Buinevičiūtė, A. (2020). *Tarptautinis matematikos ir gamtos mokslų tyrimas TIMSS 2019*. Vilnius: ŠMM ir NŠA.

6. *Europos Komisija*. (2012). Komisijos komunikatas Europos Parlamentui, Tarybai, Europos ekonomikos ir socialinių reikalų komitetui ir Regionų komitetui. Elektroninių viešųjų pirkimų strategija. Retrieved from https://eimin.lrv.lt/lt/veiklos-sritys/viesuju-pirkimu-politika/europos-sajungos-dokumentai/komunikatai.

7. Geros mokyklos koncepcija. (2015). Patvirtinta LR Švietimo ir mokslo ministro, 2015 m. gruodžio 21 d. Nr. V-1308. Retrieved from https://www.e-tar.lt/portal/lt/legalAct/f2f65120a7bb11e5be7fbe3f919a1ebe (žiūrėta 2021 06 30).

8. Grabauskienė, V. and Mockaitytė-Rastenienė, O. (2016). Matematinio kūrybingumo ugdymas mokantis logiškai tiksliai samprotauti II klasėje. *Pedagogika, 121* (1), 23–40.

9. Grabauskienė, V. and Zabulionytė, A. (2018). The Employment of Verbal and Visual Information for 3rd Grade Deaf Students in Arithmetic Story Problem Solving. *Pedagogika, 129*(1).

10. Grakauskaitė-Karkockienė, D. (2002). *Kūrybos psichologija*. Vilnius: Logotipas.

11. Guilford, J. P. (1987). Creativity research: Past, present, and future. *Frontiers of creativity research: Beyond the basics*, 33–65.

12. Ivcevic, Z. and Mayer, J. D. (2006). Creative types and personality. *Imagination, cognition, and personality, 26* (1-2), 65-86.

13. Kardelis, K. (2016). *Mokslinių tyrimų metodologija ir metodai*. Kaunas: Judex.

14. Kaufman, J. and Beghetto, R. (2009). Beyond Big and Little: The Four C Model of Creativity. *Review of General Psychology*, 13 (1), 1-12.

15. Kondratavičienė, R. and Sičiūnienė, V. (2021). Expression of primary school students critical and creative thinking in mathematics // *ECER 2021 : European conference on Educational Research, Geneva, 6 September 2021 [online]: abstracts book*. Geneva, p. 2032. Retrieved from https://eera-ecer.de/ecer-programmes/conference/26/contribution/51659.

16. Kondratavičienė, R., Sičiūnienė, V., Grakauskaitė-Karkockienė, D., and Karčauskienė, K. (2019). Lithuanian teachers' gifted education perceptions and attitudes // *ECER 2019: European conference on Educational Research, Hamburg, Germany, 3-6 September 2019: abstracts book*. Bern : VETNET, 2019, p. 1962. Retrieved from https://eera-ecer.de/ecer-programmes/conference/24/contribution/48230.

17. Krulik, S. and Rudnick, J. A. (1993). Reas*oning and problem solving: A handbook for elementary school teachers*. Boston: Allyn and Bacon.

18. Mak, D. K., Mak, A. T., and Mak A. B. (2017). *Solving everyday problems with the scientific method: thinking like a scientist*. Singapore World Scientific Publishing Co. Pte. Ltd.

19. Mann, E. L. (2005). *Mathematical creativity and school mathematics: indicators of mathematical creativity in middle school students*. Storrs, CT.: University of Connecticut.

20. Narkevičienė, B. (2007). *Gabūs vaikai: iššūkiai ir galimybės*. Kaunas: Technologija.

21. Norvaiša, R. (2019). Why do we teach the mathematics that we do? *Lietuvos Matematikos Rinkinys, (60)*, 21-26.

22. OECD. (2019). *OECD Employment Outlook 2019: The Future of Work*. Paris, France: OECD Publishing. doi: 10.1787/9ee00155-en.

23. Petrulytė, A. (2001). *Kūrybiškumo ugdymas mokant*. Vilnius: Presvika.

24. Petrulytė, A., Beresnevičienė, D., and Samašonok, K. (2004). Mokinių kūrybiškumas ir mokymosi sėkmė. *Ugdymo psichologija*, (11), 53-60.

25. Plubsir, P. and Chaiyasang, S. (2020). Critical Thinking in Mathematics: A Must-Thinking Process to be Developed in Mathematics Classroom. *รายงานการประชุม วิชาการ เสนอ ผล งาน วิจัย ระดับ ชาติ และ นานาชาติ, 1*(11), 162.

26. Rudienė, A., Sičiūnienė, V., Bareikienė M., and Uinskienė, I. (2015). *2012 m. nacionalinio mokinių pasiekimų tyrimo dalykinė ataskaita* [elektroninis išteklius]: matematika, lietuvių kalba.

27. Sičiūnienė, V. and Toleikytė, N. (2017). Ar pakankamas mokytojų dėmesys mokant žemus pasiekimus turinčius mokinius skaitymo strategijų? *Pedagogika,127*(3), 37–53.

28. Sičiūnienė, V., Grakauskaitė-Karkockienė, D., and Strolienė, E. (2016). Divergentinio mąstymo ugdymas per matematikos pamokas. *Mokytojų ugdymas,* (26), 77-93.

29. Silver, E. A. (1997). Fostering creativity through instruction rich in mathematical problem solving and problem posing. *Zdm*, 29(3), 75–80.

30. Sternberg, R. J. (1997). *How Practical and Creative Intelligence Determine Success in Life*. New York: Pume.

31. Standartizavimo procedūrų aprašas. I dalis. 4 klasė. (2012). Lietuvių gimtosios kalbos (skaitymo ir rašymo) ir matematikos standartizuotos programos ir testų pavyzdžiai. Vilnius: Ugdymo plėtotės centras.

32. Treffinger, D. J., Young G. C., Selby E. C., and Shepardson, C. (2002). *Assessing creativity: A guide for educators*. Storrs, CT: National Research Center on the Gifted and Talented.

33. Vaičiūnaitė, D. and Sičiūnienė, V. (2014). *Matematinis raštingumas PISA tyrimų pagrindu. Švietimo problemos analizė, 10* (115).

34. Valstybės pažangos strategija. (2012). Lietuvos pažangos strategija „Lietuva 2030", Lietuvos Respublikos Seimo nutarimas Nr. XI-2015.Vilnius.

35. Vincent-Lancrin, S. et al. (2019). Fostering Students' Creativity and Critical Thinking: What it Means in School. *Educational Research and Innovation*. OECD Publishing, Paris, https://doi.org/10.1787/62212c37-en.

36. World Economic Forum. (2020). *The future of jobs report 2020*. Retrieved from https://www.weforum.org/reports/the-future-of-jobs-report-2020.

COINCIDENCE AND DIFFERENCE OF AGREED ATTRIBUTE IN COMPOUND LITHUANIAN, LATIN AND ENGLISH ANATOMICAL TERMS

Nijolė Litevkienė
Šiauliai State University of Applied Sciences
Lithuania

Jurgita Briedytė
Šiauliai State University of Applied Sciences
Lithuania

Annotation
It can be said that the anatomical terminology is a specific collection of scientific terms. One of the major flaws in early anatomical terminology was that body structures were described by varying names, while some of the terms were irrational in nature and confusing. At this time, different international committees were working on preparing a unified final version of the anatomical terminology. Each country wanted to have its own nomenclature. To this end, each country based its nomenclature on the international anatomical terminology, and then translated it into its own language.

According to Sakai (2007) the historical development of anatomical terminology – the oldest layer of medical terminology – can be divided into five stages: colloquial Greek words of that period used by Galen as anatomical terms; terms from the early 16th century, when Vesalius described the anatomical structures in his De humani corporis fabrica; terms from the late 16th century when Sylvius in Paris and Bauhin in Basel described muscles, vessels and nerves; terms from the 17th-19th century when anatomical textbooks were written in Latin and later in other modern languages; terms from the end of 19th century, when the first international anatomical terminology in Latin was published as Nomina Anatomica.

Keywords: English medical terminology, Latin medical terminology, Lithuanian medical terminology, aspects of medical terminology.

Introduction

Although the importance of medical language has increased enormously, "there is no recognized discipline called medical linguistics" (Wulff, 2004). Papers dealing with medical language are published in various scientific research journals, medical journals, linguistic journals, journals on teaching, conference proceedings, etc. The language of medicine poses challenges to medical professionals, medical historians, linguists, translators, undergraduate and postgraduate medical students (Džuganová, 2019).

Scientific terminology is a system of names of objects and phenomena, which helps scientists to make themselves understood. The term used to name an object or phenomenon must be unambiguous, precise and clear. Latin and ancient Greek languages have been used for such names since long ago. They are almost unchanging but have sufficient word formation reserves (Česnys, 2002). Because of its permanence and preciseness, the Latin language has been the international language of science for centuries.

Medical language is the language used by medical experts in their professional communication and has a history of more than 2500 years of development, influenced mostly by Greek and Latin medical traditions. Its specific features and characteristics are studied from various perspectives. It is closely related to the immense development of technology and science, resulting in new concepts in the language; therefore, medical vocabulary is an open and continually changing phenomenon and its units often acquire new meanings (Džuganová, 2019).

Like all languages, medical terminology has also changed over time. The basis for medical terminology, however, has remained the same (Dobrić, 2013). While the roots of written medical language can be traced back to the 5th century BC, the spoken language of medicine has naturally existed ever since the establishment of the medical profession itself (Dirckx,1983).

Medical terminology is considered to be one of the oldest specialized terminologies in the world. It is a linguistic discipline that studies, analyses and describes a specialized area of the lexicon. Medical terminology has been studied in various aspects; e.g., historical: "the Greco-Latin core of the medical terminology is a result of the historical development of medicine as a

science" (Doncu & Andronache, 2014). Most linguists have accepted Jespersen's assertion that modern science borrowed heavily from Latin and Greek roots to create compound and derived words. Other perspectives are etymological, explaining the origin and development of terms; e.g., etymon = origin of a word and + logos = word; morphological, when different meanings of the word can be obtained by means of prefixes and suffixes (added word roots) (Džuganová, 2013); semantic, describing changes in the meaning, which are as common as changes in the form. Like the latter, they can be internally or externally motivated. There are changes at the semantic level, widening and narrowing the meaning, and at the syntactic level, marked by frequent nominalization (Džuganová, 2019).

It is estimated that about three-fourths of medical terminology is of Greek origin. The main reason for this is that the Greeks were the founders of rational medicine in the golden age of Greek civilization in the 5th century BC. The Hippocratic School and, later on, Galen (the Greek from Asia Minor, who lived in Rome in the 2nd century AD) formulated the theories that dominated medicine up to the beginning of the 18th century. The Hippocratics were the first to describe diseases based on observation, and the names given by them to many conditions are still used today. Greek medicine migrated to Rome at an early date, and many Latin terms crept into its terminology. Latin was the language of science up to the beginning of the 18th century, so all medical texts were written in Latin. Influenced by the great anatomical work *De humani corporis fabrica* (1543), written by Andreas Vesalius, the terminology of anatomy has become almost exclusively Latin.

Nowadays, the language of medicine undergoes a shift from Latin and Greek influence on medical terminology to English influence on the creation of modern international medical terms (Dobrić, 2013). This is due to modern medicine that has surpassed the boundaries of Greco-Latin terms, introducing new medical terms composed partly or wholly of words borrowed from ordinary English. Doctors from non-English-speaking countries now can choose between importing these English terms directly and translating them into their native language; e.g., bypass operation, screening, scanning (Wulff, 2014).

Coincidence cases of two-word Lithuanian anatomical terms and their Latin and English equivalents

Lithuanian medical terminology usually manifests itself in two varieties: national and international (Klimavičius 1975). In terms of origin, terms differ: they can be (1) formed on the basis of the lexis of the native language: *gimda – uterus* Vest.121, MTŽ571, ŽA412/*cf.* Eng. *uterus* AHA23, *uterus (womb)* CMD691; *nagas – unguis* Vest.34, MTŽ565, ŽA582/*cf.* Eng. *fingernail* AHA33, CMD686; *skrandis – ventriculus* Vest.104, MTŽ586, ŽA337/ *cf.* Eng. *gaster/ventriculus* AHA20, *ventricle* CMD700; *tiltas – pons* Vest.47, MTŽ451, ŽA463/*cf.* Eng. *pons* AHA28, CMD524; gimdos kaklelis – *cervix uteri* Vest.137, MTŽ99, ŽA412/*cf.* Eng. *cervix* of *uterus* PAPh938; nosies pertvara – *septum nasi* Vest.79, MTŽ498/ *cf.* Eng. *nasal septum* PAPh179; *stuburo smegenys – medulla spinalis* Vest.26, *nugaros smegenys* MTŽ329, ŽA443/*cf.* Eng. *medulla spinalis* AHA27, 28; (2) borrowed (as it has already been mentioned, most commonly, Latin and ancient Greek languages are used): *dentinas – dentinum* Vest.108, MTŽ140, ŽA322/*cf.* Eng. *dentine* CMD174; *odena – sclera* Vest.51, ŽA551/*cf.* Eng. *sclera* AHA536, CMD591; *emalis – enamelum* MTŽ169, ŽA323/*cf.* Eng. *enamelum* AHA135, *enamel* CMD; and, finally, mixed or hybrids: danties *pulpa – pulpa* dentis MTŽ464 *cf.* Eng. *pulpa dentis* AHA135 (Litevkienė, Lauruškienė 2012).

Due to the long lasting reticence of countries' international scientific relations, the medicine science of each country formed a distinctive nomenclature. Eventually, this resulted in a great confusion in anatomical terms due to the names for newly discovered parts of human organs, chosen based on different principles.

However, most terms in medical terminology are compound terms. According to A. M. Rassinoux, compound terms are most productive. S. W. Haas, R. M. Losee studied cases of the use of terms and their frequency in natural languages (Losee R. M., Haas S. W. 1995). According to V. Danilenko, only word combinations can have an exact scientific expression because the more words make up the term, the more precisely it can be expressed (Danilenko 1986).

According to foreign scholars E. Marecková, F. Simon , L. Cervený, Latin compound terms form a separate group in medical terminology. Their productivity is determined by the suitability of the Latin language to express the thought economically and concisely when the mother tongue equivalent is expressed in a paraphrase (Marecková, Simon, Cervený, 2002). Compound two-word terms denoting *main* parts and organs of the human body in the international document *Nomina Anatomica* are in the minority.

Compound terms, as a separate kind of terms, were first distinguished and named by our prominent linguist J. Jablonskis in 1913, reviewing K. Jaunius' *Grammar of the Lithuanian Language*. He called multi-word terms *compound terms* (Gaivenis 1975).

Lithuanian, Latin and English compound anatomical terms usually consist of two or three words. Multi-word (four-word to eight-word) compound terms are very rare.

Discussing the aspects of coincidence and difference of constituents of Lithuanian, English and Latin terms, it is necessary to note that Latin and English languages do not have pronominal forms of the adjective or participle. Lithuanian pronominal adjectives have a determinative and emphatic meaning. In Latin and English languages, adjectives do not have such meanings (Litevkienė,Lauruškienė 2012).

Most attributive constituents are made up of adjectives with suffixes *-inis, ė*. What are the Latin and English equivalents of these attributive constituents? Based on the definitions of the meanings of the substantial suffix, three groups of Latin and English suffix equivalents can be distinguished:

Meaning of suffix	Suffixes of constituents of compound Latin terms	Suffixes of constituents of compound English terms
- Belonging to the object expressed by the main word or the link to that object	- alis, e;-aris,e	- aris, e - ilis, e - al
- Property-related belonging (Skardžius, 1935, 68).	- icus, a, um mean belonging	- ic
- Similarity to the object expressed by the main word	- ideus, a, um mean similarity	- idus, e
- Material from which something is made (Skardžius, 1935, 68).	- eus, a, um - aceus, a, um mean material	- eus - ens

Suffixes - inis, ė (attribute) + noun (determinative) ≡[1] noun (determinative) + adjective (attribute) ≡ noun (determinative) + adjective (attribute) (Litevkienė, Korosteliova 2011):

$$A^{2}_{Nn} + S_n \leftrightarrow S_n + A_N \leftrightarrow A_N + S_n$$

žiauninis lankas	–	arcus branchialis MTŽ48	arcus branchialis TMP38.
alveolinė atauga	–	processus alveolaris MTŽ456	process alveolaris TMP420;
poakinė sritis	–	regio infraorbitalis MTŽ478	regio infraorbital, TMP405;
žandinis antis	–	sinus maxillaris MTŽ501	maxillary sinus PAPH180;
sąnarinis paviršius	–	facies articularis MK18	articular surface TMP165;

Pronominal adjective (attribute) + noun (determinative) ≡ noun (determinative) + adjective (attribute) ≡ adjective (attribute) + noun (determinative):

$$A_{NI} + S_n \leftrightarrow S_n + A_N \leftrightarrow A_N + S_n$$

tikrieji šonkauliai	–	costae verae Vest.26	false ribs CMD576
minkštasis gomurys	–	palatum molle Vest.107	soft palate CMD479.
netikrieji šonkauliai	–	costae spuriae Vest.26	false ribs CMD576
blyškusis kamuolys	–	globus pallidus MTŽ227	pale globe, globus pallidus TMP193
kietasis gomurys	–	palatum durum Vest.107	hard palate CMD479

Mixed formation adjective with the suffix - inis, ė (attribute) + noun (determinative) ≡ noun (determinative) + compound adjective (attribute) ≡ compound adjective (attribute) + noun (determinative):

$$A_{Nn} + N_N \leftrightarrow N_N + A_{Nn} \leftrightarrow A_N + N_N$$

seromukozinė liauka	–	glandula seromucosa Vest.34, MTŽ225	seromucosal gland TMP183, AHA33
abiausė linija	–	linea biauricularis MTŽ310	biauricular line TMP280
apygyslaininis tarpas	–	spatium perichorioidale MTŽ504	perichorioidal space TMP493;

[1] ≡ identical to

[2] A – adjective, N – numeral, S – noun, Pr – pronoun, N – nominative, G – genitive, p – positive degree, comp – comparative degree, s – superlative degree, i – pronominal, n – suffix - inis,ė, S – compound, m – of mixed formation, P – participle, pos – positive degree, C – ordinal

paliežuvinė liauka	–	*glandula sublingualis Vest.104*	*sublingual gland PaPh773*
poliežuvinis latakas	–	*ductus sublingualis MTŽ156*	*sublingual canal TMP134*
tarpslankstelinė anga	–	*foramen intervertebrale ŽA62*	*intervertebral foramen PaPh191*

Pronominal passive or active participle (attribute) + noun (determinative) ≡ noun (attribute) + participium praesentis activi (determinative) ≡ noun (attribute) + participium praesentis activi (determinative):

$$P_{NI} + S_n \leftrightarrow S_n + P_N \leftrightarrow P_N + S_{nm}$$

nusileidžiančioji aorta	–	*aorta descendens MTŽ43*	*descending aorta PaPh646*
ištekamoji gysla	–	*vas efferens MTŽ577*	*vas efferens TMP575*
jungiamasis latakas	–	*ductus reuniensMTŽ156*	*ductus reuniens PaPh649*
atitraukiamasis nervas	–	*nervus abducens MTŽ369*	*nerve abducens PaPh434*
įtekamoji gysla	–	*vas afferens MTŽ577*	*vas afferens TMP576*

Nominative of pronominal superlative adjective (attribute) + nominative of noun (determinative) ≡ nominative of noun (determinative) + nominative of superlative adjective (attribute) ≡ nominative of noun (determinative) + nominative of superlative adjective (attribute): $A_{NI} + S_n \leftrightarrow S_n + A_N \leftrightarrow S_n + A_N$. Only one such case was found. Superlative adjectives in Lithuanian, Latin and English compound terms denote the maximum (minimum) amount of the property of parts of the human body or of structural points in the area of the human body. Coincidence cases of two-word compound Lithuanian, Latin and English terms containing superlative adjectives could be found in clinical terminology, when names of a symptom, diseases, diseased conditions, disorders are indicated (Brunevičiūtė, 2001): *ilgiausias raumuo – musculus longissimus MTŽ354 – musculus longissimus PaPh66* (Litevkienė, Korosteliova 2011). Such coincidence in two-word anatomical terms is rare.

Compound two-word terms contain two-thirds of the configurations discussed. It can be stated that those configurations are typical of anatomical terminology. Usually, the constituents of two-word compound terms are presented in a certain order: attribute + determinative; in Latin, determinative + attribute; in English, determinative + attribute. Sometimes the attribute can precede the determinative. According to A. Dumčius, K. Kuzavinis and R. Mironas, if the attributes denoting *place* or *time* precede the determinative, they have a predicative meaning, and if the go after the determinative, they have attributive meaning (Dumčius et al., 1999). It can be argued that practicably such terms are rare. Only two combinations containing such configurations of Lithuanian, Latin and English terms were found (Litevkienė, Lauruškienė 2012).

Nominative of pronominal adjective (attribute) + nominative of noun (determinative) ≡ nominative of adjective (attribute) + nominative of noun (determinative) ≡ nominative of adjective (attribute) + nominative of noun (determinative): $A_{NI} + S_N \leftrightarrow A_N + S_N \leftrightarrow A_N + S_N$: *švelnusis dangalas – pia mater Vest.47, MTŽ437 – pia mater PaPh377; kietasis dangalas – dura mater Vest.47, MTŽ156 – dura mater PaPh377* (Litevkienė, Korosteliova 2011).

Cases of differences between two-word Lithuanian anatomical terms and their Latin and English equivalents

According to the provisions of the PNA (Parisiensia Nomina Anatomica), in anatomical terminology, adjectives denoting the location of parts and organs of the human body as well as the quantitative properties of organs and parts of the body are related by an opposition relation, in other words, antithesis (Litevkienė, Lauruškienė 2012).

$$A_{NI} + S_N \leftrightarrow A_N + S_N \leftrightarrow S_N + A_N$$

mažasis (žastikaulio) gumburėlis	–	*tuberculum minus (humeri) MTŽ560*	*tubercle lesser PaPh200*
didysis (žastikaulio) gumburėlis	–	*tuberculum majus (humeri) MTŽ560*	*tubercle greater PaPh200*

The analysis of the examples enables to state that comparatives are used in Latin compound terms to distinguish the determinative because they denote a considerable or excessive degree of a quality (Allen, Greenough 2002). We use pronominal adjectives to express permanent, characteristic peculiarities, and this way we distinguish objects and living things noted by them. For this reason, they could be called exclusive adjectives. Pronominal adjectives are used when something needs to be distinguished by a permanent, distinct peculiarity, more clearly noted or indicated.

Hence, specific constituents of Lithuanian compound terms, expressed by pronominal adjectives, and constituents of Latin and English compound terms, expressed by gradable adjectives, are used for distinguishing parts and organs of the body according to their qualitative peculiarities. Therefore, it can be stated that in such case, the categorical meanings of words do not coincide. The symmetrical position of parts and organs of the human body with respect to the longitudinal axis is indicated by the attributes of two-word compound terms (Litevkienė,Lauruškienė 2012).

dešinysis	*dexter MTŽ145*	*dexter TMP122*
kairysis	*sinister MT501*	*sinister TMP501*

kairysis inkstas	–	*ren sinister MTŽ480*	*left kidney PaPh392*
dešinysis inkstas	–	*ren dexter MTŽ480*	*left kidney PaPh392*
dešinysis skilvelis	–	*ventriculus dexter Vest91*	*right ventricle PaPh594*
kairysis skilvelis	–	*ventriculus sinister Vest91*	*left ventricle PaPh594*

The first group of Lithuanian two-word compound terms, Latin and English two-word compound terms: Lithuanian two-word terms ↔ Latin two-word terms ↔ English two-word terms. Several subtypes of this type are distinguished.

According to K. Gaivenis, in terminology, pronomination is important (to distinguish the kind), but gradation of adjectives is meaningless (Gaivenis 2002). The analysis of terms found in various sources enables to state that there are compound terms in anatomical terminology, one constituent of which is expressed by the comparative adjective or the superlative adjective. This type of compound terms occurs in the systematics of angiology (Litevkienė, Korosteliova 2011).

However, ambiguity arises when Lithuanian, Latin and English terms with this configuration are compared: $A_{Nlpos} + S_N \leftrightarrow S_N + A_{Ncomp} \leftrightarrow A_{Ncomp} + S_N$

The following cases were found:

$$A_{Nlpos} + S_N \leftrightarrow A_{Ncomp} + S_N \leftrightarrow S_N + A_{Ncomp}$$

mažasis (žastikaulio) gumburėlis	–	*tuberculum minus (humeri) MTŽ560*	*tubercle lesser PaPh200*
didysis (žastikaulio) gumburėlis	–	*tuberculum majus (humeri) MTŽ560*	*tubercle greater PaPh200*
mažoji (skrandžio) kreivė	–	*curvatura (ventriculi) minorMTŽ129*	*curvature lesser PaPh59*
didžioji (skrandžio) kreivė	–	*curvatura (ventriculi) miajorMTŽ129*	*curvature greater PaPh59*

1. Nominative of pronominal adjective (attribute) + nominative of noun (determinative) ≠[3] nominative of noun (determinative) + nominative of comparative adjective (attribute) ≠ nominative of comparative adjective (attribute) + nominative of noun (determinative).

$$A_{Nlpos} + S_N \leftrightarrow A_{Ncomp} + S_N \leftrightarrow A_{Ncomp} + S_N$$

mažoji taukinė	–	*omentum minus MTŽ390*	*lesser omentumCMD459*
didžioji taukinė	–	*omentum majusMTŽ390*	*greater omentumCMD459*

In Lithuanian two-word compound terms, we find the positive pronominal adjective, while in Latin compound terms and in English terms, their equivalents are comparative degrees. Agreed adjectives of such compound two-word terms do not coincide in the structural aspect: pronominal adjective – comparative adjective – superlative adjective. Do these compound terms have the same limits of identity?

The constituents of two-word terms denote the same qualitative properties of structural points of the same parts of the body. Practicably, agreed adjectives of this type mean the same peculiarity. In this type of terms, logically identical peculiarities are expressed by different lexical units.

The analysis of the terms of the above-mentioned type allows to state that to define the differences of the organ or structural unit, to highlight a greater or lesser amount of peculiarity of one or another part of the body, in Lithuanian anatomical terms, specific constituents are expressed by the positive adjective; while in Latin and English terms, by the comparative adjective. Such two-word compound terms are unproductive (Litevkienė, Korosteliova 2011).

---

[3] ≠ non-identical to

2. Nominative of adjective with suffix –inis, ė (attribute) + nominative of noun (determinative) ≠ nominative of noun (determinative) + nominative of comparative adjective (attribute) ≠ nominative of noun (determinative) + nominative of comparative adjective (attribute).

$$A_{Nn} + S_N \leftrightarrow S_N + A_N \leftrightarrow S_N + A_N$$

viršutinė galūnė	–	extremitas superior ŽA205	limb superior AHA241
apatinė galūnė	–	extremitas inferior ŽA205	limb inferior AHA241
viršutinė (jungiančioji) vena	–	vena (anastomotica) superior MTŽ579	vena (anastomotica) superior AHA400
viršutinė landa (nosies)	–	meatus (nasi) superiorŽA366	meatus superiorPaPh722
priekinis paviršius	–	facies anterior ŽA93	facies anterior AHA400
viršutinis kraštas	–	margo superiorŽA94	margo superiorŽA94
užpakalinis kraštas	–	margo posteriorŽA94	margo posteriorŽA94
apatinė landa (nosies)	–	meatus (nasi) inferiorŽA366	meatus inferiorPaPh722

It can be hypothesized that such two-word compound terms are characteristic of *anatomical* terminology.

3. Nominative of adjective with suffix –inis, ė (attribute) + nominative of noun (determinative) ≠ nominative of noun (determinative) + genitive of noun (attribute) ≠ nominative of adjective (determinative) + nominative of noun (attribute).

$$A_{Nn} + S_N \leftrightarrow S_N + S_G \leftrightarrow A_N + S_N$$

epiduralinė ertmė	–	cavum epidulareMTŽ95	epidular cavity TMP74
sąnarinė ertmė	–	cavum articulareMTŽ95	articular cavity TMP74
sėdmeninė vaga	–	crena aniMTŽ125	gluteal cleftTMP105
būgninė ertmė	–	cavum tympaniMTŽ96	tympanic cavityTMP74
sraiginis latakas	–	ductus cochlearisMTŽ155	cochlear ductPaPh492

4. Nominative of prenominal adjective or adjective with suffix –inis, ė (attribute) + nominative of noun (determinative) ≠ nominative of noun (determinative) + nominative of participle (determinative)) ≠ nominative of adjective (attribute) + nominative of participle (determinative).

$$A_{NIn} + S_N \leftrightarrow P_N + S_G \leftrightarrow A_N + P_N$$

laisvieji šonkauliai	–	costae fluctuantesŽA76	floating ribsPaPH193
pastovieji dantys	–	dentes permanentesMTŽ180	dentes permanentesAHA135
sėklinis latakas	–	ductus deferensMTŽ155	ductus deferensAHA22
protiniai dantys	–	dentes sapientesVest.109	dentes sapientesAHA135

5. Nominative of present tense passive voice pronominal participle (attribute) + nominative of noun (determinative) ≠ nominative of noun (determinative) + nominative of adjective (determinative) ≠ nominative of adjective (attribute) + nominative of noun (determinative).

$$P_{NI} + S_N \leftrightarrow P_N + A_N \leftrightarrow A_N + S_N$$

regimasis laukas	–	tractus opticusVest.52	optic tractPaPh485
sėdimasis nervas	–	nervus ischidiacusMTŽ371	sciatic nerve PaPh398
regimasis nervas	–	nervus opticusVest.53	nervus opticusPaPh474

6. Nominative of present tense passive voice pronominal participle (attribute) + nominative of noun (determinative) ≠ nominative of noun (determinative) + nominative of adjective (attribute) ≠ nominative of noun (determinative) + nominative of adjective (attribute).

$$P_{NI} + S_N \leftrightarrow S_N + A_N \leftrightarrow S_N + A_N$$

kramtomasis raumuo	–	musculus massenterMTŽ354	musculus massenterAHA122
sukamieji raumenys	–	musculi rotatoresMTŽ350	musculi rotatoresAHA68
keliamieji raumenys	–	musculi levatores MTŽ350	musculi levatores AHA68

The second group of Lithuanian two-word compound terms and their Latin and English equivalents: Lithuanian two-word ↔ Latin one-word ↔ English one-word terms. Two subtypes of this type are distinguished.

1. Nominative of adjective with suffix –inis, ė (attribute) + nominative of noun (determinative) ≠ nominative of compound noun ≠ nominative of compound noun.

$$A_{Nn} + S_N \leftrightarrow S_{NS} \leftrightarrow S_{NS}$$

priekinės smegenys	–	prosencephalonŽA440	prosencephalon (forebrain) AHA492
galinės smegenys	–	telencephalonŽA442	telencephalon AHA492
rombinės smegenys	–	rhombencephalonŽA442	rhombencephalonAHA492 (hind brain)
vidurinės smegenys	–	mesencencephalonŽA439	mesencencephalonAHA492 (mid brain)
tarpinės smegenys	–	diencephalonŽA442	diencephalon AHA492

2. Nominative of pronominal adjective (attribute) + nominative of noun (determinative) ≠ nominative of noun ≠ nominative of noun.

$$A_N + S_N \leftrightarrow S_N \leftrightarrow S_N$$

galvos smegenys	–	encephalonMTŽ171	encephalonAHA89
tikroji oda	–	dermisVest.33	dermisPaPh127
didžiosios smegenys	–	cerebrumŽA459	cerebrumAHA27
tiesioji žarna	–	rectum Vest.123	rectumAHA19

The third group of Lithuanian two-word compound terms and their Latin and English equivalents: Lithuanian two-word ↔ Latin three-word ↔ English three-word terms. Two subtypes of this type are distinguished.

1. Nominative of simple or pronominal ordinal (attribute) + nominative of (compound) noun (determinative) ≠ nominative of noun (determinative) + nominative of adjective (attribute) + nominative of ordinal (attribute) ≠ nominative of ordinal (determinative) + nominative of (compound) noun (determinative) + nominative of noun (attribute).

$$N_{N(I)} + S_{N(S)} \leftrightarrow S_N + N_N \leftrightarrow N_{CN} + N_N + N_N$$

antrasis pleištukas	–	os metacarpale secundum ŽA134	second metacarpal bonePaPh204
pirmasis delnakaulis	–	os metacarpale primumŽA134	first metacarpal bonePaPh204
trečiasis pleištukas	–	os metacarpale tertiumŽA134	third metacarpal bonePaPh204

2. Nominative of pronominal adjective or adjective with suffix –inis,ė (attribute) + nominative of compound noun (determinative) ≠ nominative of adjective (attribute) + nominative of adjective (attribute) ≠ nominative of adjective (attribute) + nominative of noun (determinative).

$$A_{NIn} + S_{NS} \leftrightarrow A_N + A_N + S_N \leftrightarrow A_N + S_N$$

priedinė skydliaukė	–	glandula thyreoidea accessoriaŽA424	thyroid glandTMP192
giliosios limfagyslės	–	vasa lymphatica profundaMTŽ577	lymphatic systemTMP526
paviršinės limfagyslės	–	vasa lymphatica superficialiaŽA302	Lymphatic systemTMP526

In anatomical terminology, specific compound constituents are more common in Latin and English structural types. It has been noticed that two thirds of the studied Lithuanian two-word compound terms are terms related by syntactic relations of agreed attribute. Such Latin and English two-word compound terms constitute more than 70 per cent of all terms.

Conclusions

According to Sakai (2007), the historical development of anatomical terminology (the oldest layer of medical terminology) can be divided into five stages: colloquial Greek words of that period used by Galen as anatomical terms; terms from the early 16th century, when Vesalius described the anatomical structures in his *De humani corporis fabrica*; terms from the late 16th century, when Sylvius in Paris and Bauhin in Basel described muscles, vessels and nerves; terms from the 17th-19th century, when anatomical textbooks were written in Latin and later in other modern languages; terms from the end of the 19th century, when the first international anatomical terminology in Latin was published as *Nomina Anatomica*.

Medical terminology provides interesting, useful and unique information for the history of medicine in Lithuania (what health issues were topical, what diseases were common and how

they were treated, what were the means of prevention, who treated patients and where this was done etc.) as well as for the research of Lithuanian language and terminology. Some terms which are currently used in the language of medical science were used 100 years ago, but in general, medical terminology of that time differs from the modern terminology in the use of a figurative sense, Lithuanian origin and the variety of meanings and expression (Zemlevičiūtė, 2018).

The majority of Lithuanian and Latin anatomy terms are two-word terms. According to syntactic relations of the main and secondary constituent, Lithuanian and Latin two-word terms are divided into two groups; i.e., with agreed attribute and with non-agreed (governed) attribute, which may be expressed in the following formula. Two thirds of Lithuanian two-word terms and almost two thirds of Latin two-word terms consist of terms related by syntactic relations of the agreed attribute.

Lithuanian two-word terms, Latin and English equivalents form 24 grammatical configurations.

Most of the Lithuanian two-word terms consist of *the nominative of the adjective with the suffix -inis, -ė + the nominative of the noun*, while Latin and English two-word terms are made up of *the nominative of the noun + the nominative of the adjective* ($A_{Nn} + S_N \leftrightarrow S_N + A_N \leftrightarrow A_N + S_N$; $A_{Nnm} + S_N \leftrightarrow S_N + A_{NS} \leftrightarrow A_{Nn} + S_N$). The specific attribute of Lithuanian and English anatomical terms usually precedes the determinative. Latin compound terms are characterized by an inverse order of the constituents of compound terms.

Resources

AHA: Frick, H. et al. (1990). *Atlas of Human Anatomy.* Switzerland: Karger.

MTŽ: Astrauskas, V. et al.(1980). *Medicinos terminų žodynas*. Vilnius: Mokslas.

PAPh: Tortora J. G., Grabowski R. S. (1993). *Principles of anatomy and physiology*, New York: Addison-Wesley Educational Publishers.

ŽA: Pavilonis, S. et al. (1984). *Žmogaus anatomija.* Vilnius: Mokslas.

TPM: Arnaudov, G. D. (1964). *Terminologia medica poliglotta*. Bulgaria: Medicina et physcultura.

Vest.: Vestonas, T.(1997). Anatomijos atlasas. Vilnius: Gamta.

References

1. Geenough, Kittredge, G. L., Howard, A. A., (2006). *New Latin Grammar*. Dover publications.

2. Česnys, G. (2002). Lietuviškojo anatomijos vardyno istorijos metmenys. *Terminologija*, No. 9, (p. 55–65).

3. Danilenko – Даниленко, В. П. (1986). Актуальные направления лингвистического исследования русской терминологии. *Современные проблемы русской терминологии*. (р. 5–23).

4. Dirckx, J. H. (1983). The language of medicine: its evolution, structure and dynamics.(2nd edition). N. York: Praeger, (193 pages).

5. Dobrić, K. (2013). Creating Medical Terminology: From Latin and Greek Influence to the Influence of English as the Current Lingua Franca of Medical Communication. *JAHR*; 4 (7), 493–501.

6. Doncu, R. E., Andronache, L. F. (2014). Greek and Latin nomenclatures in medical language. 348–352. Retrieved from http://www.diacronia.ro/ro/indexing/details/A14584/pdf.

7. Džuganová, B. (2019). *Medical Language – A Unique Linguistic Phenomenon.* Slovakia: Comenius University, Martin. Vol. 10(19), 129–145.

8. Dumčius, J., Kuzavinis K., Mironas, R. (1999). *Elementa Latina*. Vilnius: Jandrija.

9. Gaivenis, K. (1975). Dvižodžiai sudėtiniai terminai dabartinėje lietuvių kalboje. *Lietuvių terminologija. Lietuvių kalbotyros klausimai*, 57–89.

10. Gaivenis, K. (2002). Lietuvių terminologija: teorijos ir tvarkybos metmenys. Vilnius: LKI l – kla.

11. Gielecki, J., Żurada, A., Osman, N. (2008) Terminologia anatomica in the past and the future from perspective of 110th anniversary of Polish Anatomical Terminology. *Folia Morphol.*, Vol. 67 (2).

12. Klimavičius, J. (1975). Tarptautinių ir lietuviškų terminų sinonimija terminologijoje. *Lietuvių kalbotyros klausimai*, Vol19, 91–123.

13. Litevkienė N., Korosteliova (2011). J. *Compound Latin, Lithuanian English Anatomical Terms.* Vārds un tā pētīšanas aspekti Nr. 15(II) Liepājas Universitāte, 204–210.

14. Litevkienė, N., Lauruškienė, R. (2012). Lietuviškosios ir lotyniškosios anatomijos terminijos istorinė raidos apžvalga. *Profesinės studijos: teorija ir praktika.* Vol.10, 13–18.

15. Marečkova, E., Simon, F., Červeny, L. (2002). Latin as the Language of Medical Terminology: some remarks on its role and prospects. *Swiss Medwkly,* Vol. 132, 581–587.

16. Répás, L. (2013). *Basics of Medical Terminology Latin and Greek origins*. Compiled by La" SZLO" RE"PA"S, DEBRECEN, 1–14.

17. Losee, R. M., Haas, S. W. (1995). Sublanguage terms – dictionaries usage and autonomic classification. *Journal of the American Society for Information Science*. Vol. 46 (7), 519–529.

18. Sakai, T. (2007). Historical evolution of anatomical terminology from ancient to modern. Vol. 82(2), 65–81.

19. Wulff, H. R. (2004). The language of medicine. *J R Soc Med*, 187–188.

20. Zemlevičiūtė, P. (2018). Medicinos terminija prieš 100 metų *Terminologija*. 2018. Vol. 25, 147–200.

COMPUTER SIMULATION OF CLAMPING JAWS WITH ELASTIC COMPENSATING LINKS FOR THIN-WALLED PARTS CLAMPING

Ihor Lutsiv
Ternopil Ivan Puluj National Technical University
Ukraine

Vitalii Voloshyn
Ternopil Professional College of Ternopil Ivan Puluj National Technical University
Ukraine

Ihor Los
Ternopil Ivan Puluj National Technical University
Ukraine

Annotation
The paper deals with the study of clamping jaws with elastic compensating links which have the properties of adaptation to the clamping surfaces of thin-walled work-pieces and ensure the accuracy of their centering. Basing on the method of finite element analysis using a CAD/CAE system, the dependences of the deformations of the jaw clamping section depending on its wall thickness and force loading on the plungers were obtained. According to the computer simulation results the locations of concentration of the maximum equivalent stresses in the clamping jaw with an elastic compensation link and their values are determined.
Keywords: adaptive clamping jaw, thin-walled part, centering accuracy, stress-strain condition, elastic deformations

Introduction

The shape accuracy of the thin-walled working parts after turning is largely determined by the parameters of the clamping system. Most often, jaw chucks are used for basing and fixing thin-walled work-pieces during turning operations, allowing clamping thin-walled work-pieces of different size. They are advantageous in terms of machining cost and readjustment time. Clamping thin-walled work-pieces with cylindrical base surfaces of different diameters by clamping jaws with a fixed geometry of their clamping surface leads to different contact conditions. When clamping such work-pieces with commercially available power-operated lathe chucks, there is sometimes a problem of insufficient centering accuracy, despite the previous fine machining of "soft" clamping jaws. Therefore, the development and study of clamping jaws with elastic compensation links, which have the properties of adaptation to the clamping surfaces of thin-walled working parts as well as ensuring the accuracy of their centering is an urgent scientific and engineering task.

Research goals and objectives

Taking into account the requirements for the turning process of thin-walled working parts, much attention should be paid to the clamping elements used to equip the turning chucks. The main requirements for the design of such clamping elements are: adaptation (ensuring full contact) to the surface of the part, high centering accuracy, sufficient clamping stiffness, rapid readjustment [1-3]. The paper [4] deals with the results of local strains in the contact zone of traditional and segmental clamping jaws when fixing the thin-walled work pieces of the ring type in the turning chucks. This study allows defining more precisely dependences for the calculation of torque and clamping forces to prevent local damages in the contact area. The strategy of reducing deviations from the roundness of turned rings when they are clamped with a three-jaw chuck is given in [5]. This strategy is used first for the external clamping with traditional jaws, and then - segmental jaws for the inner clamping. The finite element method is used here to simulate the ring deformations. Adaptive system to compensate the errors taking place when clamping the thin-walled cylindrical work-pieces is given in the paper [6]. The operational element of this system is designed in the form of the mechatronic holder with integrated sensor and piezoelectric drive for the turning tool displacement. As well, in the paper [6] the developed models of cutting depth control in various angular positions of the thin-walled work piece are also resulted taking into account deformations of the work piece and the tool. To actively compensate the displacement of the work piece during clamping on lathes the papers [7, 8]

develop a new method of accurate positioning using an active chuck. This technique provides that the position of the work piece is determined by two tactile displacement sensors. The clamping chuck consists of built-in piezoelectric actuators that compensate the eccentric displacement and decline errors. The corrected position of the work piece is fixed by a friction lock caused by the tensile force.

Many scientific investigations in the leading technical universities as well as in the companies that are engaged in manufacturing of clamping devices deal with the development of devices design with adaptive properties and also in research of their characteristics [7-11]. To ensure the adaptation of the clamping jaw to the work pieces of variety of diameters, different principles are used [9-11], in particular: mechanical (sliding pins; plates; flexible segments, etc.); thermal (low-melting materials and low-melting metals); magnetic (magnetic powders, magneto-rheological fluids); hydraulic (liquid and granular media (granules)).

The analysis of numerous designs of adaptive clamping elements, based on the mechanical principle of adaptation, shows the presence of elastic links in them.

Based on the mentioned above, increasing the accuracy of centering of thin-walled work-pieces with cylindrical base surfaces can be achieved by developing clamping jaws with elastic compensation links that have adaptive properties.

The object of the study is the clamping jaws with elastic compensation links that ensure the accuracy of centering of the thin-walled work-pieces with cylindrical base surfaces.

The objective of the study is to increase the accuracy of centering of thin-walled work-pieces with cylindrical base surfaces due to clamping jaws with elastic compensation links and evaluation of their stress-strain condition at different design and power parameters.

Research techniques

One of the basic approaches in creating clamping jaws with adaptive properties, which is proposed to use, is the deliberate deformation zones introduction into their design [10, 11]. This concept allows synthesizing clamping jaws with elastic compensation links, to ensure the fitting of their contact surface to the clamping surface of a thin-walled work-piece and making moving it to ensure the accurate centering.

Using this approach, the design of a clamping jaw with elastic compensation links for clamping thin-walled parts with cylindrical base surfaces (Fig. 1), which contains a hydraulic medium, is synthesized.
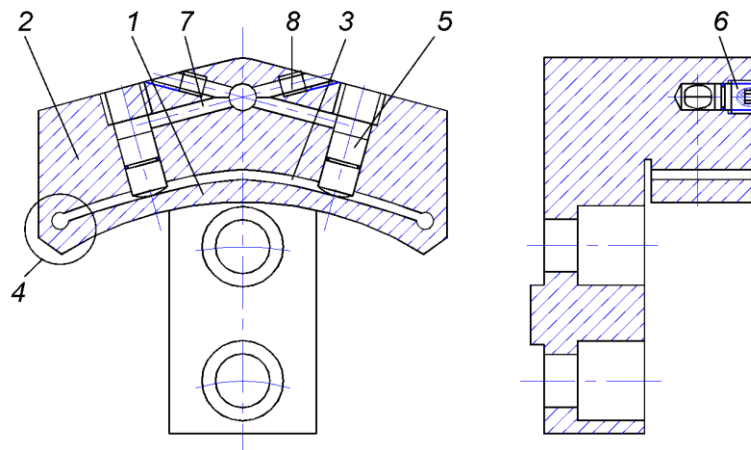

Fig.1. Clamping jaw with elastic compensation links for clamping thin-walled parts with cylindrical base surfaces

Its characteristic feature is to ensure uniform distribution of pressure on the clamping surface due to the elastic connection of the clamping section 1 with a base section 2. The cavity 3 is made almost along the entire width of the clamping jaw and is tangential to its radial movement. The clamping section 1 is connected to the base section 2 by means of solid body hinged joints 4, which gives it elastic properties in the radial direction and has a favorable effect on ensuring a uniform pressure distribution on thin-walled work-piece. The moving drive of the clamping section 1 is made hydraulically, so that a constant tension is created between the sections of the clamping jaw. Actuation of the clamping section 1 is carried out by the piston plungers 5 under the pressure of the liquid, which is created by the screw 6 located at the end of the clamping jaw. This allows easy access to the clamping jaw even when the work-piece is clamped. Precise hydraulic adjustment is provided by turning the screw 6 with a wrench. When

turning the screw, the hydraulic fluid is displaced into the channels 7 and acts on the piston plungers 5. Piston plungers 5 press on the inner area of the clamping section 1.

The stroke of the plungers leads to the desired expansion of the clamp radius by a small amount when clamping by section 1. The hydraulic system for moving the clamping section 1 allows ensuring its precise adjustment, which leads to the precise centering of thin-walled work-piece, as well as to the fitting of the jaw contact surface to its clamping surface. Screw caps 8 of the hydraulic channels 7 are used to fill in and pump the hydraulic system.

Due to the complicated design of the proposed clamping jaw it is necessary to solve problems related to the quantitative assessment of the stress-stain state of the clamping section as well as an influence of structural and power parameters on it. Therefore, the method of finite element analysis using CAD/CAE system is chosen.

Using the method of 3D parametric modeling, a solid model of a clamping jaw with an elastic compensation link (Fig. 2,a) was created for a clamping chuck with a body diameter of 200mm. The calculation model was prepared by creating a finite element grid. The grid was developed on a 3D model of fairly accurate hexahedral and tetrahedral finite elements. The grad dimensions were chosen to be variable. In the areas of solid-body hinges, a finite element grid was developed with a smaller size to increase the accuracy of modeling. The finite element grid is checked and its convergence is adjusted. Fig. 2,b shows the resulting finite element grid generated by the program.
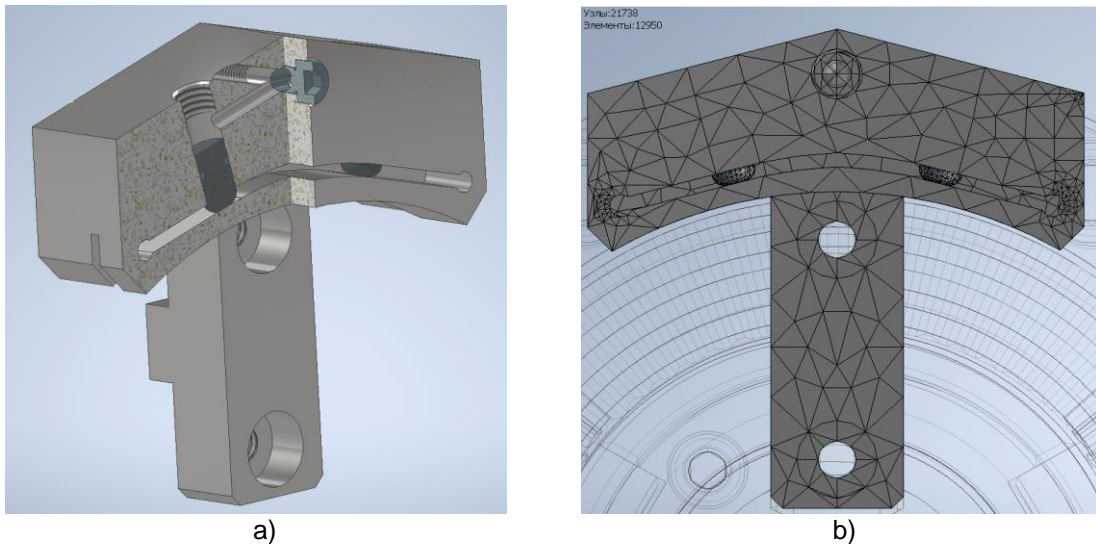

| a) | b) |

Fig.2. Solid-body clamping jaw model with elastic compensation link (a) and its model consisting of a finite element grid (b)

The initial conditions of modeling are found. Structural alloy steel with a tensile strength of 980 MPa and a yield strength of 785 MPa was selected as the material of the clamping jaw. A kinematic boundary condition of the "fixation" type was chosen for the base section of the clamping jaw. The condition of the plunger contact with the inner surface of the clamping section is accepted such that the faces can be moved in any directions relative to each other (with the possibility of both partial breakage and sliding). In order to study the force effect from the plungers on the stress-strain condition of the clamping jaw, a load was applied to them in the form of a static boundary condition of the type "normal force". This power load varied from 100N to 1000N. Finite element modeling was performed in a static setting; the model was considered linear-elastic.

Results of static finite elements analysis

The results of modeling of clamping jaw with an elastic compensation link by the method of finite element analysis are equivalent stresses, which values were calculated basing on the Richard von Mizes hypothesis of the shape changing energy, as well as deformations. According to the simulation results, the locations of the maximum equivalent stresses σ_e in the clamping jaw with elastic compensation link and their values are found. Analysis of patterns of equivalent stresses σ_e distribution over the volume of the clamping jaw (Fig. 3,a) shows that their largest values will be in the area of the solid-body hinge joints. The maximum equivalent stresses σ_e in the area of the solid-body hinge joints of the clamping jaw, obtained by computer simulation at different force loadings P on the plunger and different values of the wall thickness t of the jaw clamping section are shown in the Fig. 3,b.

The simulation results show that with the force load P on the plungers increasing from minimum to maximum, the maximum equivalent stresses σ_e also increase, i.e. there is a direct proportional linear dependence between these parameters. In this case, for the clamping section wall thickness from 2 to 4 mm at the same force load P on the plungers, the maximum equivalent stresses σ_e differ by a small value (from 10 to 16%).

Analysis of the simulation results showed that the clamping section under clamping force loadings in the range of 100…1000N operates in the elastic deformations zone.

The study was also conducted dealing with the deformations of the jaw clamping section depending on its wall thickness t and the force load P on the plungers. Analysis of deformation patterns (Fig. 4,a) shows that the largest displacements δ occur in the area of the central part along the vertical axis of symmetry of the clamping jaw.

The maximum displacements in the area of the central part along the vertical axis of symmetry of the clamping jaw, obtained as a result of computer simulation at different force loadings P on the plungers and different values of wall thickness t of the jaw clamping section, are shown in Fig. 4,b.
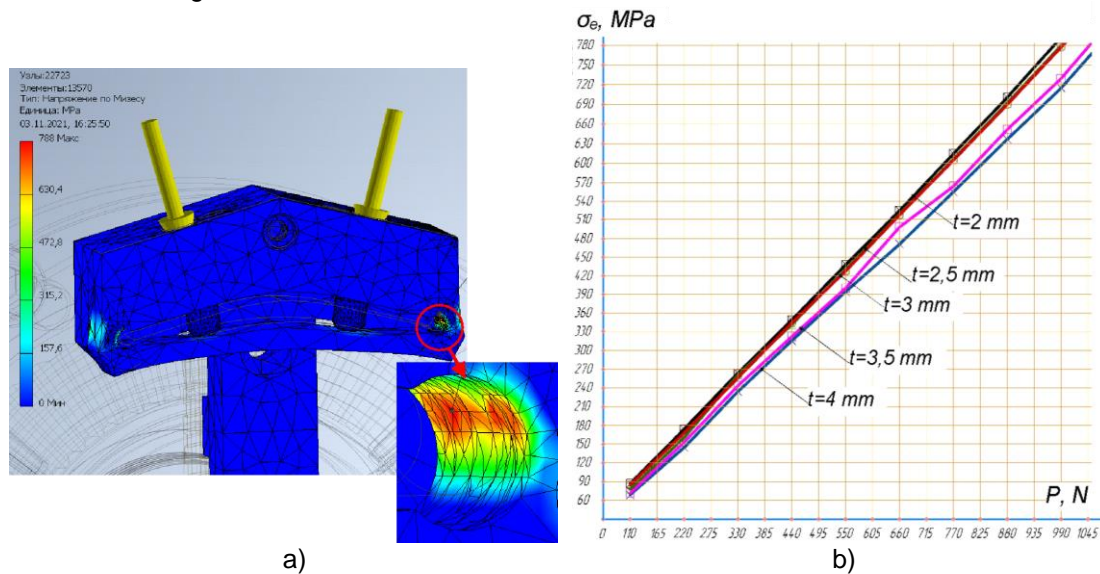

a)　　　　　　　　　　　　　　　　　　b)

Fig.3. Pattern of stress distribution on the volume of the clamping jaw (a) and graphical dependences of the maximum equivalent stresses σ_e in the area of the solid-body joints on the force P on the plungers and the wall thickness t of the clamping section (b)

a)　　　　　　　　　　　　　　　　　　b)
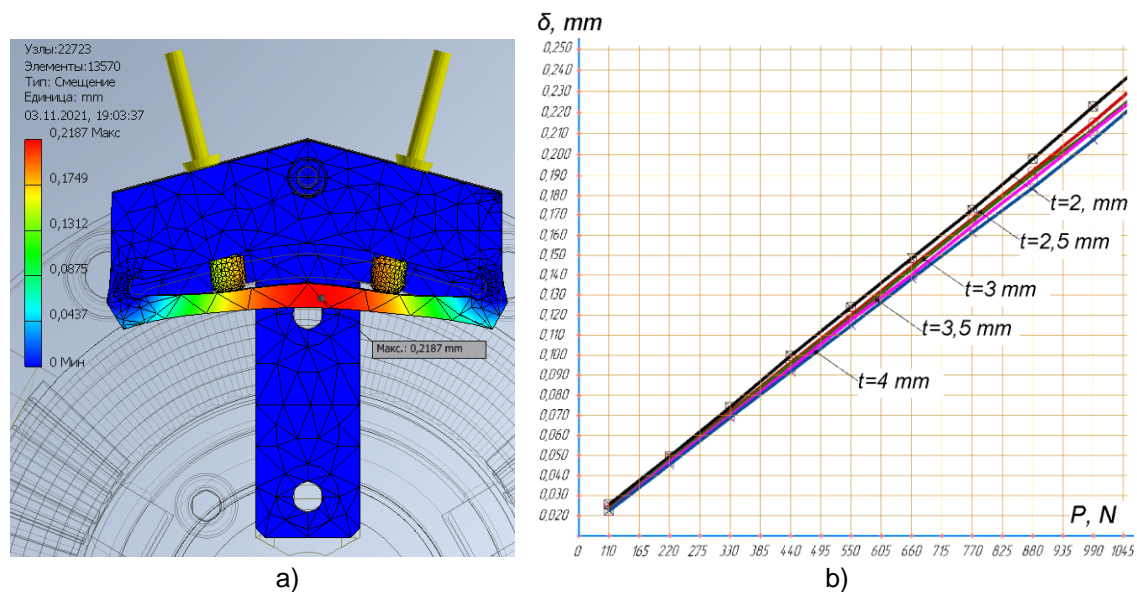
Fig.4. Deformations pattern of the jaw clamping section (a) and graphic dependences of the maximum displacements δ on the force P on the plungers and wall thickness t of the clamping section (b)

The simulation results show that with the force loading P on the plungers increasing from minimum to maximum, the maximum displacements of the jaw clamping section also increases

i.e. there is a direct proportional linear dependence between these parameters. With an increase in wall thickness from 2 to 4 mm at the maximum force loading P=1000 H on the plungers, the maximum displacements δ decrease by 7%.

The maximum displacements δ in the area of the central part along the vertical axis of symmetry of the clamping jaw under the force loads of the plungers in the range of 100…1000N and wall thickness of the clamping section from 2 to 4 mm are in the range of 0.023…0.0235mm. Such values of displacements allow providing the corresponding values of correction at a clamping of thin-walled work-pieces with cylindrical base surfaces for ensuring accuracy of centering at finishing turning.

Conclusions

1. Using the developed method, a mathematical description of the jaw clamping section deformation depending on its wall thickness and force loadings on the plungers is obtained. This model is to be used to determine the correction values to ensure accurate centering of thin-walled work-pieces with cylindrical base surfaces.

2. The study was performed by the finite element method of a clamping jaw with an elastic compensation link, on the basis of which the displacements and equivalent stresses were determined. Their values were calculated basing on the Richard von Mizes hypothesis of shape changing energy. The results of the study show a directly proportional linear dependence between the loads acting on the plungers and maximum equivalent stresses and deformations. It is found that the locations of concentration of the maximum equivalent stresses are on the zone of solid hinge joints of the clamping jaw.

3. The simulation results show that the jaw clamping section under the force loads of the plungers in the range of 100…1000 N operates in the zone of elastic deformations. It is determined that the maximum displacements in the area of the central part of the clamping jaw vertical axis of symmetry section from 2 to 4 mm are in the range of 0.023…0.0235 mm. These values allow ensuring the accuracy of centering of thin-walled work-pieces with cylindrical base surfaces, due to the elastic compensating links of the clamping jaws.

References

1. Кузнецов Ю., Волошин В., Неделчева П., Эль-Дахаби Ф. (2010). Зажимные механизмы для высокопроизводительной и высокоточной обработки резанием: монографія. Габрово: Васил Априлов.

2. Кузнецов Ю., Драчев О., Луцив И., Шевченко А., Волошин В. (2014). Зажимные механизмы и технологическая оснастка для высокоэффективной токарной обработки: монография. Старый Оскол: ТНТ.

3. Кузнецов Ю., Драчев О., Волошин В. (2016). Принципы создания станочно-инструментальной оснастки для высокоэффективной токарной обработки: монография. Старый Оскол: ТНТ.

4. Estrems M., Carrero-Blanco J., Cumbicus W.E., Francisco O., Sánchez H. (2017). Contact mechanics applied to the machining of thin rings. Procedia Manufacturing. – Issue 13, pp. 655–662.

5. Solter J., Grote C., Brinksmeier E. (2011). Influence of clamping strategies on roundness deviations of turned rings. Machining Science and Technology: An International Journal. - Volume 15, Issue 3, pp. 338–355.

6. Heisel U., Kang C. (2011). Model-based form error compensation in the turning of thin-walled cylindrical parts. Production Engineering. – Volume 5, Issue 2, pp. 151–158.

7. Denkena B., Hülsemeyer L. (2014) Active fine positioning chuck for industrial turning applications/ 14th International Conference on New Actuators and Drive Systems (ACTUATOR 14) Bremen Germany, pp. 584–587

8. Denkena B., Hülsemeyer L. (2015) Investigation of a fine positioning method in lathes using an active clamping chuck/ Euspen's 15th International Conference & Exhibition, Leuven, Belgium, pp. 245–246.

9. Bahrke U. (1998). Flexible Spannbacken für die Drehbearbeitung: Diss. Berlin: IPK.

10. Lutsiv I., Voloshyn V., Bytsa R. (2015). Adaptation of lathe chucks clamping elements to the clamping surface. Machines, Technologies, Materials. International journal. – Issue 12., pp. 64–67.

11. Bytsa R. (2017). Justification characteristics of lathe chucks with adaptive clamping elements: Ph.D. thesis. Ternopil: Ternopil Ivan Puluj National Technical University.

JBE. CONCEPT AND APPLICATION

Lydia Mitkovets
PhD of Belarusian State University of Informatics and Radioelectronics Lithuania
Belarus

Daniel Sidorov
PhD of Belarusian State University of Informatics and Radioelectronics Lithuania
Belarus

Alevtina Gourinovitch
PhD of Belarusian State University of Informatics and Radioelectronics Lithuania
Belarus

Annotation
To save the information inside storage users try to reduce the files size to minimum by using data compression software. It is a new algorithm for data compression in this article. It is j-bit encoding (JBE). This algorithm manipulates each bit of data inside file to minimize the size without losing any data after decoding. It is classified lossless compression. This basic algorithm is combining with other data compression algorithms to optimize the compression ratio. The implementation of this algorithm consists in a combination of various data compression algorithms.
Keywords: compression, encoding, source encoding.

Introduction
Data compression is an algorithmic transformation of data to reduce the amount of data it occupies. This algorithm is applied for efficiency using of storage and data transfer devices.

Compression is based on eliminating the redundancy contained in the source data. The simplest example of redundancy is the repetition of fragments in the text (for example, words of natural or machine language). Such redundancy is usually eliminated by replacing the repeated sequence with a reference to the already encoded fragment with an indication of its length. Another type of redundancy is related to the fact that some values in the compressed data are more common than others. The reduction in data volume is achieved by replacing frequently occurring data with short code words, and rare data with long ones (entropy coding). Compression of data that does not have the property of redundancy (for example, random signal or white noise, encrypted messages) is fundamentally impossible without loss.

At the heart of any compression method is the data source model, or more precisely, the redundancy model. In other words, data compression uses some a priori information about what kind of data is being compressed. Without such information about the source, it is impossible to make any assumptions about the transformation that would reduce the volume of the message. The redundancy model can be static, immutable for the entire compressed message, or constructed or parameterized at the compression (and recovery) stage.

All data compression methods are divided into two main classes:
- Lossless compression
- Lossy compression

When using lossless compression, it is possible to completely restore the original data, lossy compression allows you to restore data with distortions that are usually insignificant from the point of view of further use of the restored data. Lossless compression is usually used for the transmission and storage of text data, computer programs, less often-to reduce the volume of audio and video data, digital photos, etc., in cases where distortion is unacceptable or undesirable. Lossy compression, which is significantly more efficient than lossless compression, is usually used to reduce the volume of audio and video data and digital photos in cases where such reduction is a priority, and full compliance of the original and restored data is not required.

Data compression is a way to reduce storage cost by eliminating redundancies that happen in most files. There are two types of compression, lossy and lossless. Lossy compression reduced file size by eliminating some unneeded data that won't be recognize by human after decoding, this often used by video and audio compression. Lossless compression on the other hand, manipulates each bit of data inside file to minimize the size without losing any data after decoding. This is important because if file lost even a single bit after decoding, that mean the file is corrupted.

Most compression methods are physical and logical. They are physical because look only at the bits in the input stream and ignore the meaning of the contents in the input. Such a method translates one-bit stream into another, shorter, one. The only way to understand and

decode of the output stream is by knowing how it was encoded. They are logical because look only at individual contents in the source stream and replace common contents with short codes. Logical compression method is useful and effective (achieve best compression ratio) on certain types of data [1].

RELATED ALGORITHMS
A. Run-length encoding
Run-length encoding (RLE) is one of basic technique for data compression. The idea behind this approach is this: If a data item d occurs n consecutive times in the input stream, replace the n occurrences with the single pair nd [1]. RLE is mainly used to compress runs of the same byte. This approach is useful when repetition often occurs inside data. That is why RLE is one good choice to compress a bitmap image especially the low bit one, example 8-bit bitmap image.

B. Burrows-wheeler transform
Burrows-wheeler transform (BWT) works in block mode while others mostly work in streaming mode. This algorithm classified into transformation algorithm because the main idea is to rearrange (by adding and sorting) and concentrate symbols. These concentrated symbols then can be used as input for another algorithm to achieve good compression ratios. Since the BWT operates on data in memory, you may encounter files too big to process in one fell swoop. In these cases, the file must be split up and processed a block at a time [2]. To speed up the sorting process, it is possible to do parallel sorting or using larger block of input if more memory available.

C. Move to front transform
Move to front transform (MTF) is another basic technique for data compression. MTF is a transformation algorithm which does not compress data but can help to reduce redundancy sometimes [4]. The main idea is to move to front the symbols that mostly occur, so those symbols will have smaller output number. This technique is intended to be used as optimization for another algorithm likes Burrows-wheeler transform.

D. Arithmetic coding
Arithmetic coding (ARI) is using statistical method to compress data. The method starts with a certain interval, it reads the input file symbol by symbol, and uses the probability of each symbol to narrow the interval. Specifying a narrower interval requires more bits, so the number constructed by the algorithm grows continuously. To achieve compression, the algorithm is designed such that a high-probability symbol narrows the interval less than a low-probability symbol, with the result that high-probability symbols contribute fewer bits to the output. Arithmetic coding, is entropy coder widely used, the only problem is its speed, but compression tends to be better than Huffman (other statistical method algorithm) can achieve [1]. This technique is useful for final sequence of data compression combination algorithm and gives the most for compression ratio.

PROPOSED ALGORITHM
J-bit encoding (JBE) [7] works by manipulate bits of data to reduce the size and optimize input for another algorithm. The main idea of this algorithm is to split the input data into two data where the first data will contain original nonzero byte and the second data will contain bit value explaining position of nonzero and zero bytes. Both data then can be compress separately with other data compression algorithm to achieve maximum compression ratio. Step-by-step of the compression process can be describe as below:
1. Read input per byte, can be all types of file.
2. Determine read byte as nonzero or zero byte.
3. Write nonzero byte into data I and write bit '1' into temporary byte data, or only write bit '0' into temporary byte data for zero input byte.
4. Repeat step 1-3 until temporary byte data filled with 8 bits of data.
5. If temporary byte data filled with 8 bits then write the byte value of temporary byte data into data II.
6. Clear temporary byte data.
7. Repeat step 1-6 until end of file is reach.
8. Write combined output data:
     а) Write combined output data;
     б) Write data I.
     в) Write data II.
9. If followed by another compression algorithm, data I and data II can be compress separately before combined (optional).

Figure 1 shows visual step-by-step compression process for J-bit encoding. Inserted original input length into the beginning of the output will be used as information for data I and data II size.
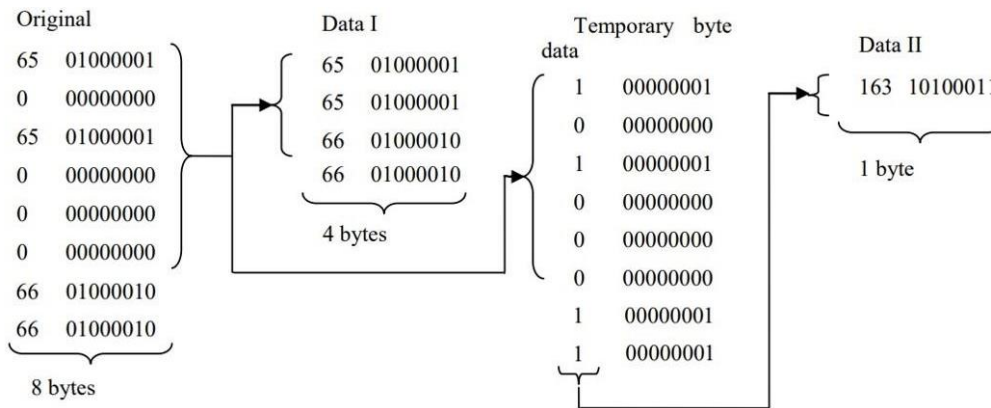

Figure 1. Step-by-step compression process for J-bit encoding

As for step-by-step of the decompression process can be describe below:
1. Read original input length.
2. If was compressed separately, decompress data I and data II (optional).
3. Read data II per bit.
4. Determine whether read bit is '0' or '1'.
5. Write to output, if read bit is '1' then read and write data I to output, if read bit is '0' then write zero byte to output.
6. Repeat step 2-5 until original input length is reach.

COMBINATION COMPARISON

Four combinations of data compression algorithm are used to find out which combination with the best compression ratio.

The combinations are:
1. BWT+MTF+ARI.
2. BWT+RLE+ARE.
3. RLE+BWT+MTF+RLE+ARI (as used in [2]).
4. RLE+BWT+MTF+JBE+ARI.

Those combinations are tested with 6 types of files. Each type consists of 80 samples. Each sample has different size to show real file system condition. All samples are uncompressed, this include raw bitmap images and raw audio without lossy compression.

No	Name	Qty	Type	Spec.
1	Image	80	Bitmap Image	Raw 8 bit
2	Image	80	Bitmap Image	Raw 24 bit
3	Text	80	Text Document	
4	Binary	80	Executable, library	
5	Audio	80	Wave Audio	Raw
6	Video	80	Windows Media Video	VBR

Figure 2. Samples for the experiment

PRACTICAL APPLICATION OF JBE
The structural data compression system looks like this:
Source Data –> Encoder –> Compressed Data –> Decoder –> Recovered Data
In this scheme, the data generated by the source is defined as the source data, and its compact representation is defined as compressed data. The data compression system consists of an encoder and a source decoder. The encoder converts the source data to compressed

data, and the decoder is designed to recover the source data from the compressed data. The recovered data generated by the decoder can either exactly match the original data of the source, or slightly differ from them.

In lossless compression systems, the decoder recovers the source data absolutely accurately, so the structure of the compression system is as follows:

Data Vector X –> Encoder –> B (X) –> Decoder - > X

The vector of source data X to be compressed is a sequence $X = (x_1, x_2, \dots, x_n)$ of finite length. The samples x_i – the components of the vector X – are selected from the finite alphabet of data A. In this case, the size of the data vector n is limited, but it can be arbitrarily large. Thus, the source at its output forms as data X a sequence of length n from the alphabet A.

The vector of source data X to be compressed is a sequence $B(X) = (b_1, b_2, \dots, b_n)$, размер которой k зависит от X. Let's call B(X) the codeword assigned to vector X by the encoder (or the codeword into which vector X is transformed by the encoder). Since the compression system is non-destructive, the same vectors $X_l = X_m$ must correspond to the same code words $B(X_l) = B(X_m)$.

EXAMPLE USING BWT+MTF+ARI
Let the input string be "ABACABAA".
1. BWT.

The conversion is performed in three stages. At the first stage, a table of all cyclic shifts of the input string is compiled. At the second stage, lexicographic (in alphabetical order) sorting of the table rows is performed. In the third step, the last column of the conversion table is selected as the output row. The following example illustrates the described algorithm:
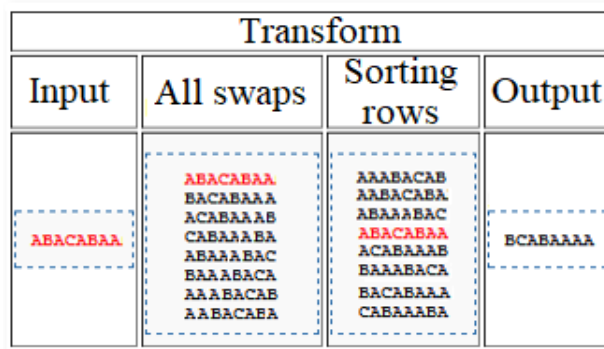

Figure 3. BWT conversion algorithm

Thus, the result of the BWT(s) algorithm is "BCABAAAA".
2. MTF.

Initially, each possible byte value is written to a list (alphabet), in a cell with a number equal to the byte value, i.e. (0, 1, 2, 3, ..., 255). This list changes as the data is processed. As the next character arrives, the number of the element containing its value is sent to the output. After that, this symbol moves to the beginning of the list, shifting the remaining elements to the right.

Modern algorithms (for example, bzip2) use the BWT algorithm before the MTF algorithm, so as an example, consider the string S = "BCABAAAA" obtained from the string "ABACABAA" as a result of the Burroughs-Wheeler transformation (more on it later). The first character of the string S = "B" is the second element of the alphabet "ABC", so the output is 1. After moving 'B' to the beginning of the alphabet, it takes the form"BAC". Further work of the algorithm:

Table 1

MTF conversion algorithm

Symbol	List	Output
B	ABC	1
C	BAC	2
A	CBA	2
B	ACB	2
A	BAC	1
A	ABC	0

A	ABC	0
A	ABC	0

Thus, the result of the MTF(S) algorithm is "12221000".

3. ARI.

Trying on arithmetic coding we get:

ARI(S)=101110100111101001001000

Thus, if we are dealing with eight-bit characters, then the input is 8*8=64 bits, and the output is 24, that is, the compression ratio 62,5%.

Consider the same example, but with the addition JBE - BWT+MTF+JBE+ARI:

Points 1 and 2 are the same.

4. JBE.

Table 2

Algorithm for applying JBE encoding

Original		Data 1		Temporary byte data		Data 2	
1	00000001	1	00000001	1	00000001	248	11111000
2	00000010	2	00000010	1	00000001	-	-
2	00000010	2	00000010	1	00000001	-	-
2	00000001	2	00000010	1	00000001	-	-
1	00000000	1	00000001	1	00000001	-	-
0	00000000	-	-	0	00000000	-	-
0	00000000	-	-	0	00000000	-	-
0	00000000	-	-	0	00000000	-	-

At the output, we have a record of the original input length + Data record I + Data record II =24812221.

5. ARI.

Trying on arithmetic coding we get:

ARI(S)=101110111011001100110110

Thus, if we are dealing with eight-bit characters, then the input is 8*8=64 bits, and the output is 24, that is, the compression ratio 62,5%.

RESULT

Figure 4 shows that 8-bit bitmap images are compressed with good compression ratio by algorithms that combined with J-bit encoding.

Figure 4. Diagram of the ratio of compression of 8-bit bitmaps between different algorithms

Figure 5. Diagram of the ratio of compression of 24-bit bitmaps between different algorithms

Figure 6. Diagram of the ratio of text file compression between different algorithms

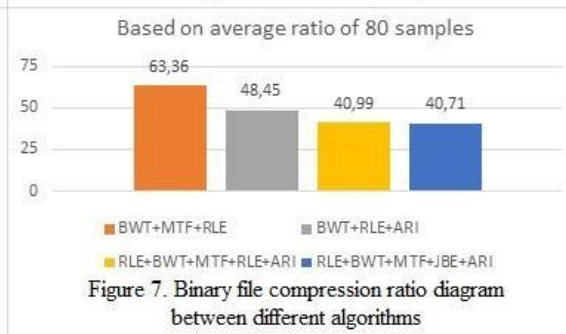Figure 7. Binary file compression ratio diagram between different algorithms
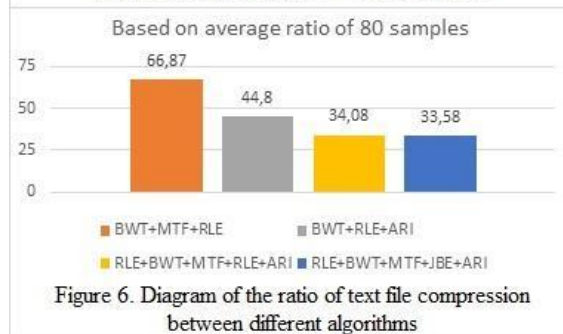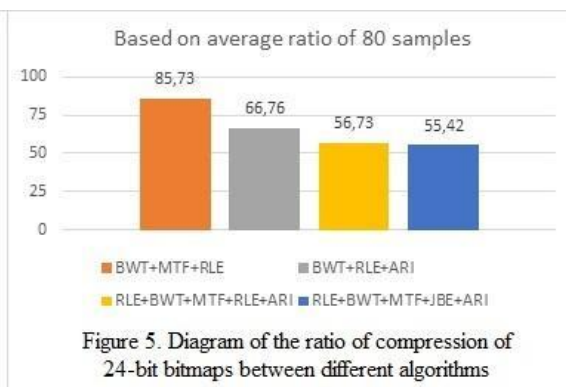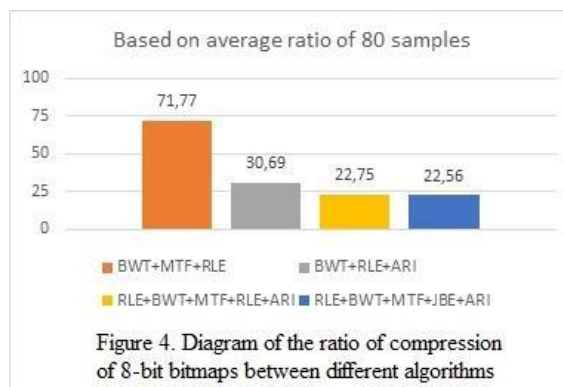
Figure 5 shows that 24-bit bitmap images are compressed with better compression ratio by algorithms that combined with J-bit encoding. A 24-bit bitmap image has more complex data than 8 bits since it is storing more color. Lossy compression for image would be more appropriate for 24-bit bitmap image to achieve best compression ratio, even thought that will decrease quality of the original image.

Figure 6 shows that text files are compressed with better compression ratio by algorithms that combined with J-bit encoding.

Figure 7 show that binary files are compressed with better compression ratio by algorithms that combined with J-bit encoding.

Figure 8. Diagram of the ratio of compression of wave audio files between different algorithms

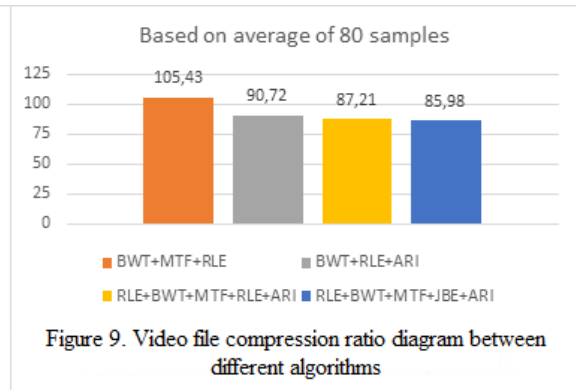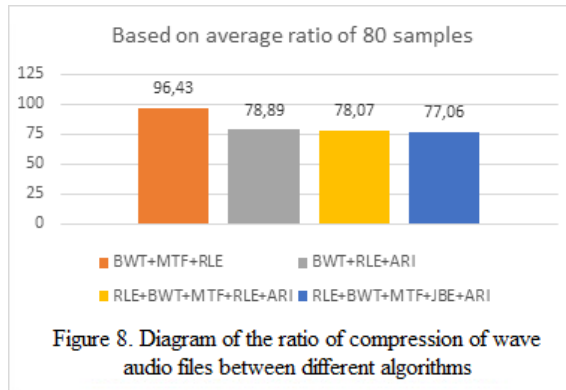Figure 9. Video file compression ratio diagram between different algorithms

Figure 8 shows that wave audio files are compressed with better compression ratio by algorithms that combined with J-bit encoding.

Figure 9 shows that video files are compressed with the best compression ratio using algorithms combined with J-bit encoding.

Conclusion

So, in the course of the study, a modified data compression algorithm was proposed and an experiment was conducted using 6 file types with 80 different sizes for each type. As a result, 4 combinational algorithms were tested and compared. The proposed algorithm gives a better compression ratio when inserted between" forward motion transformation " (MTF) and arithmetic encoding (ARI). The study provides both the theoretical part and practical examples. The considered algorithm has the prospect of introducing other data compression algorithms into the structure.

References

1. Salomon, D. 2004. Data Compression the Complete References Third Edition. Springer-Verlag New York, Inc.

2. Nelson, M. 1996. Data compression with Burrows-Wheeler Transform. Dr. Dobb's Journal.

3. David Salomon, 2010. Handbook of Data Compression Fifth Edition. Springer-Verlag New York, Inc.

4. Agus Dwi Suarjaya, 2012. A New Algorithm for Data Compression Optimization. Information Technology Department Udayana University. Bali, Indonesia.

DETERMINATION OF THE OPTIMAL COMMODITY NOMENCLATURE BY PROFIT AND COST

Vasiliy Novikov
Belarus State Economic University
Belarus

Anna Zenevich
Belarus State Economic University
Belarus

Anna Kirilyuk
Belarus State Economic University
Belarus

Annotation
The work proposes a method of definition of commodity classifications (goods nomenclature) based on the nomenclatural function. The advantage of the proposed method is the possibility of definition of commodity classifications even when the profit on every single unit of the nomenclature differs. The basis of the method is the definition of a nomenclature as a function of the geometric mean of a set of nomenclatures. That makes possible to determine the gain in the direct proportion to the value of the function of the nomenclature.

The purpose of the article is to outline the methodology for determining the nomenclature while maintaining the full range of goods. This is impossible with standard optimization using the arithmetic mean. Since the nomenclature function is a positive value, then, unlike the arithmetic mean, any item of the nomenclature cannot be zero in the geometric mean. The proposed technique is an alternative to the classical linear programming problem. The method's advantage is the absence of any additional restrictions on the parameters of the optimal solution. In principle, such restrictions can also be introduced after analyzing the solution. There are no nonlinear restrictions in the methodology, so the optimal solution can vary proportionally depending on the required value of profit or cost. We propose to implement the algorithms using the mathematical modeling program MathCad. Two variants of algorithms are considered: optimization by cost and by profit. The aim of this work is to create the most simple algorithms. The algorithms implement the optimization of the range of goods in its full assortment, that is, in the absence of zero nomenclature values.

Keywords: nomenclature function, cost function, cost incentives, geometric mean, damping vector of nomenclature, profit of unit of nomenclature, cost of unit of nomenclature.

Results and discussion

High-quality business management is based on usage of information systems of mathematic methods of data processing [1]. In connection with the transition to modern information technologies, the problem lies in the formulation of new econometric models to ensure a new quality of management [2, 3]. A large number of mathematical models in the field of economics are given in work [4, 5].

Only systematic promotion work will help to increase sales and improve the company's image. In a highly competitive environment and the trend of consumer protection, an important factor is the definition of a range of products that not only provides maximum profit, but also allows the company to stay in the competitive market. From the perspective of the missions of this company, this task is much more important in comparison with immediate profit. A reckless process of releasing goods is very dangerous from the standpoint of the company's survival in a competitive market, that is why the techniques of soft regulation of the range of goods are so important, ensuring the optimal profit of the company.

In the practice of marketing activities, both cost and non-cost incentives for promoting goods to the market are used. Cost incentive finds wider practical application, ensuring the required profit of the company. The consumer is very susceptible to buying at a discount: he is attracted by goods, the price of which is temporarily reduced. However, he is suspicious of products that are too often offered at discounted prices. Temporary price reductions have advantages and disadvantages. Some manufacturers and resellers believe that it is much more profitable to go for a price reduction, than to satisfy all new consumer demands regarding

quality, nomenclature and assortment of goods. The initiators of this incentive tend to emphasize the temporary nature of the price cut. Critics of this incentive method point out that price reductions are costly for businesses, destroys the image of the product, does not provide the proper impact on the consumer. The effectiveness of price reduction decreases when this method is often used throughout the product's life cycle. The advantage of this method is that it allows you to quickly organize it in cases where you need to immediately respond to the actions of competitors. Sale at reduced prices is especially effective when the price plays a decisive role in the choice of goods (for example, products: sugar, dairy, etc.). In this case, the consumer is interested in buying it in a particular store or retail outlet. The size of the price reduction must be tangible enough to build an advertising message on them; stimulating demand enough to compensate for falling profits; attractive enough to force the consumer to buy the product. Obviously, a decrease in the producer's price for some goods should be offset by higher prices for other goods. In such a situation, one cannot do without calculations related to the optimal volume of the nomenclature, which provides the maximum or specified profit in the mode of cost incentives [6,7].

The types of incentives based on price reductions can be divided into 3 groups: direct price reductions; distribution of coupons with the right to purchase at a discount; reduction of prices with a delay in obtaining a discount.

Direct price reductions are often initiated by the commercial network. Sometimes products of one nomenclature are combined with new items of another nomenclature or with those that require special promotion. At the initiative of the manufacturer, the price reduction is accompanied by the provision of discounts to the commercial network. If the price of the manufacturer's product is higher than the prices of competing products, the price reduction is self-evident.

Special prices or small wholesale sales are beneficial for the consumer in that he is offered a more significant price reduction of the entire batch of goods. These lots are usually sold in large wholesale markets and supermarkets.

Combined sale is used for a set of items, each of which is not a mandatory addition to the other. The price of the set is lower than the total price of each product. For a manufacturer, such a sale is effective when a new product is introduced to the market. It also allows you to combine a product that is difficult to sell separately.

In connection with the prevalence of cost incentives, the methodology for determining the range of goods at a known cost, including the cost in the process of promoting goods, is of great importance. Obviously, when the price of goods of different nomenclature changes in the market, it becomes necessary to optimally correct the volumes of the nomenclature to ensure the required profit.

The idea of an optimal process for determining the nomenclature of goods according to a strictly formalized algorithm is given in [8]. The essence of the idea is to introduce a nomenclature (X_j is the volume of the j-th nomenclature) function, which is the multiplication result of all values of X_j. From an economic point of view, this idea makes sense of unit powers of X_j, provided the same profit from a unit of the nomenclature

$$f(X)= \prod_j X_j$$

In this work, the methodology proposed in [8] is supplemented by the possibility of unambiguous determination of the nomenclature by the amount of profit. In addition, it is proposed to take products of nomenclatures with degrees different from the first, which determines the possibility of a soft or hard process of regulating the launch or introduction of certain commodity nomenclatures on the market.

If we relate the profit from the entire sold item to the function $f(X)$, then it is easy to show that this dependence will be linear only for the modified function [9]

$$f(X)= \sqrt[n]{\prod_j X_j}$$

where n- volume of the nomenclature (length of vector X). In the proposed version, $f(X)$ is from a mathematical point of view the geometric mean, and its use as a nomenclature function, in contrast to the arithmetic mean, guarantees the absence of a zero value for any of the nomenclatures.

If the profit of the units of the nomenclature is different, then the proposed method can be generalized by introducing the size of the batch of the given nomenclature in comparison with the product with the maximum profit:

$$h_j = \frac{B_k}{B_j}$$

Taking into account the function $f(X)$, optimization is carried out for each batch of goods. In addition to the function $f(X)$ and the amount of profit, the algorithm uses the target function minimized according to the criterion of the minimum cost of the batch of goods purchased by the consumer:

$$fff(X) = \sum_j A_j X_j$$

где A_j - the cost of the h_j consignment.

The proposed algorithm is easily implemented, for example, in the MathCad environment [10,11]. A fragment of the listing of the algorithm is shown below:

ORIGIN:=1

Profit from unit: $B:=(10\ 12\ 21\ 23\ 5\ 14)^T$ Item unit cost: $A:=(23\ 15\ 25\ 30\ 8\ 18)^T$

Size of vectors B and A: n:=rows(B)   j:=1..n

Nomenclature containment vector: $c:=(1\ 1\ 1\ 1\ 1\ 1)^T$

as:=max(B) $cn:=\dfrac{1}{\sum c}$

The vector of the lot size reduced to the same profit: $h_j := \dfrac{as}{B_j}$

Item batch cost: $A1_j := A_j h_j$ Nomenclature function: $f(X) := \left[\prod (X_j)^{c_j}\right]^{cn}$

Initial starting value of the item volume: $X_j := 1$

Function of the total cost of the entire item: : $fff(X) := \sum_j A1_j X_j$

Profit from whole range: $Y(X) := \sum_j B_j\ X_j$

Given

The base value of the item function: f(X)=100   X>0

The function of minimizing the total cost of the entire item

X:=Minimize(fff,X)

X^T =(62.853 115.81 121.605 110.937 90.469 112.563)   Y(X)=9152

Planned profit from the entire range: W:=12000

The final optimal value of the nomenclature volume: $xx_j := X_j \dfrac{W}{Y(X)} h_j$

xx^T :=(189.555 291.052 174.638 145.463 545.679 242.478)

The cost of the entire nomenclature

$$fff1 := \sum_j \frac{A1_j X_j}{h_j}$$ ST0:=fff1(xx) $ST0=2.619\times10^4$

Cost permissible for the organization: ST:=20000

ERR:=if(ST>ST0, "profit can be increased", "profit is unattainable")

ERR="profit is unattainable"

$$E := \frac{ST}{ST0}$$ $xx_j := xx_j\ E$

xx^T =(144.779 222.301 133.386 111.102 416.781 185.201)

Total profit: $\sum_j xx_j B_j = 1.415\times10^4$

The initial data of the problem are vectors A and B, respectively, of the cost and profit of a unit of goods, the amount of fixed profit from the entire range (the number 12000 in the given listing) and the unit vector c. The result of the program is the number of product units for each nomenclature (vector xx).Since the value of the function $f(X)$ and the profit $Y(X)$ depend linearly with each other, the value $f(X)$ in the program can be set arbitrary (in our example, the number 100 is taken).

The algorithm should be checked if the total cost of the specified limit is exceeded. If this cost is higher than the limited one, then it is concluded that it is impossible to determine the item

for the profit specified in the task. If the total cost is lower than the limited one, if desired, it is possible to increase the profit by recalculating the item at the limited cost, as is done in the above listing.

The proposed method for determining the nomenclature completely eliminates the zero volume of goods for any nomenclature. At the same time, for a given value of profit, the item is selected taking into account the consumer's rights to pay the minimum amount for it. With a different algorithm for choosing the nomenclature, the most likely outcome is the disappearance of cheap but low-profit goods from the market [12].

In the proposed method, there is a possibility of introducing non-unit powers of X_j into the functions $f(X)$ [13]. From a profit and price point of view, this makes no economic sense. However, a lower value of this degree automatically underestimates the volume of goods for a given nomenclature. Such an opportunity can be used when forcibly promoting some product to the market (degree greater than 1 in the above listing) or withdrawing a product from the market (degree less than 1). A necessary condition in this case is the condition that the total degree of all is equal to one X_j (in the above listing it is 6 * (1/6)):

$$f(X) = (X_1^{0.2} X_2^1 X_3^2 X_4^3 X_5^{0.5} X_6^{0.6})^{1/7.3}$$

As you can see from the example, the total power $f(X)$ in brackets is 7.3 and up to one it is compensated by the corresponding power outside the brackets. The powers at X_j are set in the vector c, which is expedient to take proportional to the profit. The meaning of the damping coefficients of the vector c is reduced to the following: with $c = 0.2$ - this is a fivefold forced reduction in the output of the nomenclature; with $c = 5$ – five-fold forced promotion of the release of the product nomenclature. If we assume that any item with a profit less than the maximum will be restrained in the release of the nomenclature, then the calculation of the nomenclature restraint vector c will be carried out as follows:

$$\text{as} := \max(B) \qquad c_j := \frac{B_j}{as}$$

Listing of the proposed calculation algorithm is presented below:

ORIGIN:=1
Profit from unit: B:=$(10\ 12\ 21\ 4\ 5\ 14)^T$ Item unit cost: A:= $(23\ 15\ 25\ 30\ 8\ 18)^T$

Size of vectors B and A: n:=rows(B) j:=1..n

Nomenclature containment vector:

as:=max(B) $c_j := \dfrac{B_j}{as}$ cn:=$\dfrac{1}{\sum c}$

The vector of the lot size reduced to the same profit: $h_j := \dfrac{as}{B_j}$

Item batch cost: A1$_j$:=A$_j h_j$ Nomenclature function: $f(X) := \left[\prod (X_j)^{c_j}\right]^{cn}$

Initial starting value of the item volume: $X_j := 1$

Function of the total cost of the entire item: $fff(X) := \sum_j A1_j X_j$

Profit from whole range: $Y(X) := \sum_j B_j X_j$

Given

The base value of the item function: f(X)=100   X>0

The function of minimizing the total cost of the entire item

X:=Minimize(fff,X)

X^T =(53.055 117.888 214.966 6.536 38.219 155.861)   Y(X)=8542

Planned profit from the entire range: W:=12000

The final optimal value of the nomenclature volume: $xx_j := X_j \dfrac{W}{Y(X)} h_j$

xx^T =(156.513   288.582   301.98 48.201 225.494 281.689)

The cost of the entire nomenclature

$$ff1 := \sum_j \frac{A1_j X_j}{h_j} \qquad ST0 := fff1(xx) \qquad ST0 = 2.38 \times 10^4$$

Cost permissible for the organization: ST:=20000

ERR:=if(ST>ST0, "profit can be increased", "profit is unattainable")

ERR="profit can be increased"

$$E := \frac{ST}{ST0} \qquad xx_j := xx_j\, E$$

xx^T=(131.532 242.522 253.781 40.508 189.503 236.729)

Total profit: $\sum_j xx_j B_j$=1.398×10^4

The effectiveness of such promotion of a product on the market for the consumer is attractive in that even with a rigid withdrawal of goods, the method does not give zero volume for this type of product and this leaves a chance for a product with a low cost to hold out on the market. On the other hand, the forced promotion of goods with a high value to the market will be restrained by the release of goods of a different range. In the latter case, it is necessary to forcibly set the value $c_j > 1$ according to the given nomenclature j.

The proposed algorithm for forming the nomenclature gives a result only with positive values of profit. Moreover, with positive values of profit, there will be a large error in the calculation results if the maximum value of the profit exceeds the minimum by about ten times. In these cases, it is necessary to set a fixed total cost of the item, and to carry out optimization by ensuring maximum profit [14]:

ORIGIN:=1
Profit from unit: B:=$(10 - 1\ 21\ 4\ 5\ 14)^T$ Item unit cost: A:= $(23\ 15\ 25\ 20\ 8\ 18)^T$

Size of vectors B and A: n:=rows(B)   j:=1..n

Nomenclature containment vector:

as:=max(A) $h_j = \frac{as}{A_j}$ B1$_j$:=B$_j$ h$_j$ sas:=max(B1) $c_j := \frac{B1_j}{sas}$ cn:=$\frac{1}{\sum c}$

Nomenclature function: $f(X) := \left[\prod (X_j)^{c_j}\right]^{cn}$

Initial starting value of the item volume: $X_j := 1$

Function of the total cost of the entire item: $fff(X) := \sum_j A_j X_j$

Profit from whole range: $Y(X) := \sum_j B1_j X_j$ Z(X):=$\frac{fff(X)}{Y(X)}$

Given

The base value of the item function: f(X)=10   X>0   Y(X)>0

The function of minimizing the total cost of the entire item

X:=Minimize(Z,X)

X^T=(3.823 1.007×10^{-6} 10.916 0.13 10.697 11.316)

Y(X)=658.603

Planned profit from the entire range: W:=10000

The final optimal value of the nomenclature volume: $xx_j := X_j \frac{W}{Y(X)} h_j$

xx^T =(63.091 2.548×10^{-5} 165.743 2.477 507.508 238.639)

Resulting profit

$$Y(X) := \sum_j B_j X_j \qquad Y(xx)=1.0 \times 10^4$$

There is a price maintenance strategy that has a direct impact on the price. Maintaining the price level consists in specifying prices by suppliers, above or below which other channel members are not allowed to sell their products. The main reasons for using this strategy are:

- maintaining resale prices discourages the sale of goods at reduced prices, reducing the ability of competing dealers to use the services provided by other participants for free;
- using their monopoly power in this region, dealers raise the price above the competitive level to the detriment of the interests of the manufacturer and the consumer, indicating the maximum price level, the price can be maintained at a competitive level;
- a manufacturer can increase the trade markup for advertising support and the invention of its brand, it is possible to provide discounts to offset costs and other costs to ensure competition with other brands.

In cases where the seller offers a lower price to one buyer for the same product than to another, we can say the seller provides one of them with a certain monetary reward.

In practice, such discrimination carries a lot of meaning. By using segmented pricing, management minimizes the need for compromise. Low price sensitivity buyers who require expensive service or are poorly served by competitors can charge more than high price sensitivity buyers who are cheaper to service or are well served by competitors. This discrimination increases sales and increases profitability.

The proposed methodology for the formation of the nomenclature to a large extent supports this strategy for the formation of prices, since in the interactive mode it allows, by changing prices, to form the range of goods in the optimal mode. Considering the fact that in many sectors of the economy the nomenclature of goods is regulated and constitutes one of the factors in the formation of marketing channels [15], the method of forming the nomenclature using the nomenclature function can provide an additional factor in maintaining the company's image in the eyes of consumers.

The proposed mathematical models in the work are implemented in Mathcad, but they can be implemented in Excel using the "Search for a solution" service [16, 17].

Conclusions

1. This article describes the method for defining the nomenclature without direct programming can be implemented only by means of MathCad.

2. Research has shown that the volume of the nomenclature changes in proportion to the required profit relative to the calculated profit for the fixed value of the nomenclature function.

3. As expected, the value of the optimal volume of the nomenclature essentially depends on the degrees at X_i in the nomenclature function.

4. A negative value of the specific profit gives a value close to zero in the optimal stock vector in the corresponding position.

The proposed nomenclature function makes it possible to exclude zero values of the nomenclature, which corresponds to the strategy of ensuring the nomenclature assortment of goods [18]. The methodology provides for two optimization options: cost and profit. In practice, the calculation is performed for these two options and then the most appropriate option is selected. The methodology can be supplemented with calculations for the integer variant of the commodity nomenclature units. The article does not provide explanations of the aspects of the algorithms, since these explanations are made directly in the programs on MathCad. It is assumed that the reader is familiar with programming in Mathcad. The listings given in the article are fully debugged algorithms in Mathcad.

References

1. Information systems and technologies in economics and management / under. ed. V.V. Trofimova. - M .: Higher education, 2006.
2. Naumov A. N., Quality of management of the XXI century // Management today, 2003, №6, p. 2–5.
3. Vasilevskaya I. V. Innovation management.– Moscow, Rior Publ.,2017. 480 p.
4. Crassus M. S., Chuprynov B. P. Mathematical methods and models for undergraduates in economics - M.-St.Petersburg : Peter, 2006.
5. Vlasova E. V., Glinkin E. I. Evaluation of efficiency by standardized measurement measures // Bulletin of TSU, 2017, v. 22, no. 2. - p. 51–57.
6. Kudryavtseva L. B., Kolmakova L. I. Basic concepts in the cloud of assortment policy // Bulletin of modern science, 2015, 10 (3). - pp. 35–37 of modern science, 2015, 10 (3). - p. 35–37.
7. Rusmevichientong P., Topaloglu H. Robus assortiment optimisation i revenue management the multinomial model// Operations Research, 2012, 60(4) – p. 865–882.
8. Hotomtseva, M. A., Berestneva, N. O. Workshop on the discipline "Economic and mathematical methods and models" - Minsk: MITSO, 2006.
9. Vlasova E. V., Glinkin E. I. Evaluation of efficiency by standardized measurement measures.Vestnik TGU [TSU Bulletin], 2017, vol. 22, issue 2, pp. 51–57

10. Domanova Yu. A., Chernyak A. A., Chernyak Zh. A. Mathematics based on Mathcad, general course - St. Petersburg, BHV, 2004.

11. Mathematics for economists based on MathCad / A. A. Chernyak [and others] - St. Petersburg: BHV-Petersburg, 2014.

12. Differentiation Strategy With a Product Life Cy cle Focus. Available at: https://bizfluent.com/facts-6802144-application-differentiation-business.html (accessed 26.09.2017).

13. Crawley M. J. Statistics: an introduction using R. – Wiley, 2014. – 354 p.

14. Novikov V. A., Vankovich G. R. Calculati on of commodity classifications according to the criterion of cost. – Economics and Management, 2014, no. 1 (37), pp. 15–21.

15. Stern L. Marketing channels - M., Williams, 2002.

16. Karlberg K. Business analysis using Excel. M .: Williams, 2019. 576 p.

17. Kremer N. Sh., Putko B. A., Trishin I. M., Friedman M. N. Operations Research in Economics: a Textbook for the Academic Bachelor's Degree. – Moscow, Izdatel'stvo Yurayt Publ., 2014. 438 p.

18. Ishchenko A. Assortment policy // Exclusive marketing. - 2011, 2.- p. 345-349.

CONSTRUCTION OF NURSING CULTURE IN THE CONDITIONS OF SOVIET IDEOLOGY: ESTONIAN EXAMPLE

Merle Talvik
Tallinn Health Care College
Estonia

Taimi Tulva
Tallinn Health Care College, Tallinn University
Estonia

Ülle Ernits
Tallinn Health Care College
Estonia

Kristi Puusepp
Tallinn Health Care College
Estonia

Annotation
The aim of the study is to analyse the development of nursing culture in the Estonian Soviet Socialist Republic. The analysis of scientific literature and empirical material (interviews) was conducted in 2019 and 2021. During Soviet era nursing was strongly influenced by ideology. The goal of civil protection was considered important. The nurses' daily work was characterised by poor working conditions, hierarchical employment relationship and miserable career prospects. The last decade of the Soviet period encountered the release of limits initiated by the ideas of perestroika and glasnost.

Keywords: Estonian SSR, nursing culture, Soviet ideology, propagandistic orientation, activity patterns of nurses.

Introduction
Nursing as an activity has existed throughout history, although it has evolved considerably over time. In the current health care system, nurses are one of the most trusted health care professionals with a significant role to perform in the treatment and care of the sick.

Going back to early times, there were religious practices that encouraged nuns and other religious figures to assist people suffering from illnesses. The need to help the wounded and diseased was particularly perceived in times of conflict, with wars and epidemics outbreaks.

During the period of the pre-war Republic of Estonia (1918–1940) the system focused a lot on public health and application of anti-epidemic measures, with the emphasis on nurses' training. Ideas for the development of nursing mainly came from Germany and Scandinavia. It was a period of openness and professionalism in the field of nursing.

The Soviet occupations of Estonia occurred in 1940–1941 and 1944–1991, when the territory of the Republic of Estonia was occupied by Soviet Russia and later by the Soviet Union. During the first occupation that lasted from 1940 to 1941, the Estonian SSR was annexed to the Soviet Union. In 1941, the Soviet occupation of Estonia was replaced by the German occupation. In 1944, Soviet troops conquered Estonian territory and the second Soviet occupation began.

After the forcible incorporation of the Baltic States into the Soviet Union, the nurses lost their professional status and were assimilated into the Soviet health care system as mid-level medical staff (Kalnins, Barkauskas & Šeškevičius, 2001).

The aim of the present study is to reflect the development of nursing culture and the nature of nurse's work in Estonia during the Soviet period, over 50 years. During these years health care was politicised according to the propagandistic orientation of the Soviet state. Nursing culture includes, in addition to nursing activities, norms of behaviour, attitudes and principles of being a nurse (Ernits, Talvik, Tulva, & Puusepp, 2020).

Background and starting points of the study
There is research on the history of nursing in Estonia (Aro, 2006; Kõrran, Onoper, Pruuden, Roots, Ruul-Kasemaa, Saluvere, Sarv & Õunapuu, 2008; Ernits, 2010; Ernits,

Puusepp, Kont & Tulva, 2019a; Ernits, Talvik & Tulva, 2019b; Talvik, Ernits & Tulva, 2019; Ernits et al., 2020), but an overview of Estonian nursing during the Soviet era is scarce and this study seeks to fill the gap. The authors analyse how development of nursing has been influenced by social, historical-cultural and political factors.

The main research question has arisen based on the background and sources: what was the nature and the reputation of the nurse's work and how the nursing culture was constructed in the Soviet Union as well as Soviet Estonia?

The research material consisted of historical sources, evidence-based studies, thematic interviews and an expert interview. The authors collected the sources on the history of Estonian nursing in 2019 und 2021. They mapped, systematised, generalised and analysed the sources. The methodological basis of historical research is Toomas Karjahärm's (2010) approach to historical science, according to which history reflects both the past and the present, as well as has the ability to influence future possibilities. As reported by Carr (1965), the task of history is to promote a deeper understanding of both the past and the present by studying the relationship between them. Carr claims that by generalising the past, the historian draws the boundaries of the future. (Carr, 1965).

Human experiences, which can be expressed in interviews, are a valuable research material. When an individual speaks or writes as a member of a group, his or her membership begins to influence the context through the social representation that the group shares, that is, in the form of group knowledge, attitudes, and ideologies (Dijk, 2005). These representations are manifested in people's speech, thinking and behaviour (Bauer & Gaskell, 1999), but also in cultural products (images and texts). The mentioned cultural products are physical objects that reach us, which we can also observe and analyse from a distance (Dijk, 2005). Thus, an understanding of interpretation is not possible without a context that in turn arises, and is influenced by the culture in which the activity happens.

Texts, concepts and images that have an ideological content or aspect cannot be understood, regardless of who uses them and why. In his opinion, no group can exist or function socially without the identity of the group and the ideological beliefs shared by the members of the group (Dijk, 2005).

The socio-cultural and historical context provides a framework for the analysis of the nursing culture. This interpretation considers Pierre Bourdieu's theory (1993). According to Bourdieu, "Understanding begins primarily with understanding the field what we have developed into and in opposition to" (Bourdieu, 1993, p. 38). Bourdieu is far from analysing only the "fields" but also the people in these fields, the reasons why they act the way they do. People or "social agents" do not exist in a vacuum, but in a complex institutional network that empowers, enables and legitimises their activities. The agents are free in their decisions and choices only insofar as the field allows. It offers space for possibilities for everyone involved. Due to this space of possibilities, the agents of a certain era are established in space and time and are relatively dependent on the direct conditions of the economic and social environment. The opportunities offered by history determine what is possible or impossible to do or think in one given field at the given moment in time. (Bourdieu, 2003).

Methodology

The data used in this research are based on summarising and analysing relevant evidence-based studies, which have been conducted in several European countries, especially in Latvia and Lithuania (Kalnins, 1995; Kalnins et al., 2001; Karosas & Riklikienė, 2011; Odiņa, 2013). The versatility of the research material allows the research problem to be focused on the analysis and synthesis of nursing in the context of Soviet ideology.

The authors of this study conducted thematic interviews in 2019 and 2021. Thematic analysis is one of the most common forms of analysis within qualitative research. It emphasises identifying, analysing and interpreting patterns of meaning (or „themes") within qualitative data (Braun & Clarke, 2019). "Thematic analysis is a method for systematically identifying, organising, and offering insight into, patterns of meaning (themes) across a dataset." (Braun and Clarke, 2012: 58). Students of Tallinn Health Care College Annika Tagaküla and Gundega Tammaru (2020) were involved in interviewing for the research. They used the interviews in their final thesis. The respondents included 19 nurses from different regions of Estonia. All the respondents had at least 3 years of experience working as a nurse during the Soviet era. The sampling method was snowball method (Lagerspetz, 2017). Interviews were voluntary. Pursuant to the Personal Data Protection Act (2019), informed consent to participate in the survey was obtained from respondents. The researchers explained the purpose of the study and asked for the permission to record the interview, as well as described the information processing procedure. The researchers deleted audio recordings of interviews and the answers of the interviewees after the completion of the study.

All interviewees received coded to ensure the confidentiality of the participants. The code consisted of the following indicators: number of the interviewee, nurse/expert, age, length of work experience as a nurse during the Soviet era. The researchers conducted interviews with nurses over several months from April 2019 to December 2020. In addition, an expert, namely Ilve-Teisi Remmel, a long-term (1988–2002) leader of the Estonian Nurses' Association gave an interview. She was the president of the Baltic States Nurses Association from 1991 to 1993, and she is still working in health care system today. The longest work experience of a respondent nurse during the Soviet era was 23 years, the expert's length of work experience during the Soviet era was 34 years. The coding of the general data of the respondents is characterised by Table 1.

Table 1

Respondents and their coding.

No	Nurse/ expert	Age	Years worked as a nurse during the ESSR
1	N	72	23
2	N	55	3
3	N	56	3
4	N	57	3
5	N	56	4
6	N	63	8
7	N	57	5
8	N	55	4
9	N	54	3
10	N	55	3
11	N	59	6
12	N	65	10
13	N	62	9
14	N	56	4
15	N	63	9
16	N	70	18
17	N	68	14
18	N	64	5
19	N	55	5
20	E	83	34

During the interviews, the interviewees shared their experiences on working as a nurse during the Soviet era. The following aspects were focused on: the nature of work and relations with co-workers in the work team, working conditions and tools, society's attitude towards nurses and the reputation of the nursing profession. The expert answered to the questions about how nurses were acknowledged and how Soviet ideology was reflected in the work of nurses.

The average duration of the interviews was about 30 minutes. The transcribed texts accumulated 56 pages. The expert interview lasted 40 minutes and the transcription consisted of 6 pages of text.

Thematic analysis is a flexible method that allows the data to be focused in numerous different ways (Braun and Clarke, 2012). The primary coding of the data was a "bottom-up" approach, according to what was seen in the content of the data. The review of the coded data identified commonalities and differences. As a result the coded data were grouped into themes and subtopics. Three interrelated themes (nature of work, working conditions, relations and communication) emerged, forming nine subtopics (table 2). Information on the work culture and application of ideology in nurses' work was added from the expert interview.

Table 2

Analysing interviews: thematization

Themes	Subtopics
Nature of work	The peculiarities of the era

	Application of ideology in nursing practice
	Acknowledgement of work and reputation
Working conditions	Working environment
	The specificity of the tools
	Work responsibilities
Relations and communication	The peculiarity of the work culture
	Communication with colleagues
	Sharing information with patients

The study used citations from interviews to analyse the results, and all research data as well as research results have been interpreted as objectively as possible. Adherence to ethical principles is common to all research, and this study was guided by the principles of good research: "The most important values of good research are freedom, responsibility, honesty and objectivity, respect and care, justice, openness and cooperation" (Estonian Code**…**, 2017, p. 7).

Soviet-era ideology as a constructor of nursing culture

Nursing as an activity expanded between the World War I and II. During the Republic of Estonia (1918–1940) social welfare and health care were established on a sound basis. (Kõrran et al., 2008). Before the World War II nursing profession in all three Baltic countries – Estonia, Latvia and Lithuania – was characterised by high prestige, powerful professional associations, wide international contacts, and strict control over nursing curricula (Kalnins et al., 2001). The nurses were striving for the improvement of their training and working conditions by using oral discussions through professional organisations (Karosas & Riklikienė, 2011). In practical nursing, teamwork was emphasised, and the nurse's activities were seen as cooperation between the nurses themselves and between doctors and nurses (Ernits et al., 2020).

Both the training of nurses and their status on the career ladder changed after the arrival of Soviet power (1940). Nurses were educated in vocational schools, not universities, and nursing was not considered a dignified profession. (Karanikolos, Kühlbrandt & Richardson, 2014). Later, it was possible to study in medical schools on the basis of secondary education. During the Soviet era, medical schools operated under different names, which were changed according to political decisions.

In Soviet Union polyclinics and hospitals were responsible for health care in cities. In the countryside, primary care was provided by *feldsher* and midwife aid points, more complex special treatment was offered in larger district hospitals and polyclinics (Tulva, 1995). A large-scale network of public health stations was established in the Soviet Union. This so-called sanitary-epidemiological (san-epid) service was responsible for health protection, paying special attention to the control of infectious diseases through mass vaccination, sanitary control of water resources, hygienic waste disposal and sewerage, and pasteurization of milk. In the 1950s and 1960s, the scope of the san-epid service was extended to include occupational health and environmental health. (Rechel, 2014).

The centralisation of Soviet power had a massive impact on the health care system. International contacts were scarce and closures were noticeable in all areas of life, including health care. For the Soviet state, health care was not only a right of the individual, but also a "political act" (Starks, 2017, p. 1718). The Soviet ideology promoted an ideal society, in which everybody had to fit in with socialistic standards. The Soviet period was marked by two main factors: the socialist ideology of the perfect Soviet „*tovarishch*" (comrade) and the oppression of people opposed to the political system. (Birley, 2002: 159).

Nursing was a cult profession during the Soviet era, closely associated with propaganda. Next to the figure of a female tractor driver and astronaut, there was a nurse carrying a weapon, who had participated in World War II (called "Great Patriotic War"). The male citizen was an example in constructing the ideal Soviet type of woman. Stalin-era gender policy promoted the mass involvement of women in the work process and social activities (Kivimaa, 2015), the change of their roles and the change of social attitudes.

Paternalism, as an activity that restricts the freedom or autonomy of a person or group and in which the state decides what is good for the person (Shiffrin, 2000), was a common principle in Soviet social policy. The Soviet government decided on achieving a person's quality of life, not the individual himself. According to the guidelines of paternalistic social policy nurseries and mammoth kindergartens (called "children's day homes") were founded to take care of children. This allowed mothers to make the maximum contribution to working life. Parental leave was very short, 56 days before and 56 days after childbirth (Laan, Luiga & Tamm, 1975).

In addition to educators, nurses worked in the nurseries so that one may ensure the health of children. Nurses had to perform various tasks in order to create optimal conditions for children to grow and develop and to prevent the spread of diseases. The nurses worked on the basis of a work plan agreed with the doctor, which included the following sections: treatment and prevention, control of the sanitary and hygienic regime, organisation of rational meals, prevention of infectious diseases, monitoring of daily routine, documentation and training (Laan et al., 1975).

At the same time, there was a positive aspect within the Soviet health care system: all citizens were provided with the opportunity to receive free primary medical services. The establishment of public health protection system, which was free of charge in the Soviet Union, was considered one of the most important achievements of socialism. The quality of citizens' medical services and the level of service culture depended on the professional training of mid-level medical staff, including nurses (Odiņa, 2013). On-site medical care was often provided in schools and workplaces (Healy & McKee, 1997).

The profession of a nurse in the Soviet Union was characterised by a lack of autonomy, poor working conditions and insufficient pay. The description of the main role of a nurse in publications was astounding. A nurse was described as „an indisputable executor of doctors' orders and commands". The publications never mentioned the independent role of a nurse in the assessment of patients' conditions, planning and application of nursing care (Ernits et al., 2019b, p. 15).

The nurse had to know about the diseases and be able to perform various medical procedures. The quality of the nurse's work was judged by how quickly and accurately she did her job. She had to be obedient and her independence was suppressed. "The nurse follows the doctor's orders. She performs some procedures independently, prepares the patient and instruments for more complicated procedures and assists the doctor. The ward nurse takes part in the doctor's ward visitation every day, assists him/her in observing the patients, reports the observations and receives new orders from the doctor." (Gagunova, 1977, p. 8).

Estonia was a militarised society during the Soviet era, hence the training of nurses was related to the military. In the 1950s, the political situation in the world became more alarming, therefore in the Soviet Union, reserve nurses' training was launched as courses completed either by eight months or two years. The aim of the courses was to prepare reserve nurses for the Soviet Army and Air Defence Forces. After finishing the two-year courses, the nurses were given the right to work in health care institutions. If they had worked for at least two years, their training was considered equivalent to nurses with a secondary vocational education. (Odiņa 2013).

In the 1970s, the government of the Soviet Union concentrated on the russification of the Baltic States. Therefore, Russian-speaking population was relocated to the Baltic States, where the Russian-language primary and secondary schools and Russian study groups already existed in several fields in Estonian higher education institutions, as well as in medical schools. (Hiio, 2012). All the work and training of the nurses was politicised. The nursing education curriculum was firmly unified and centralised by the government institutions of the USSR; it was not supposed to be changed or adjusted to any specifications (Toliušienė & Peičius, 2007).

During the Soviet era the profession of a nurse became unpopular among young people as study programs were changed to Soviet. A large number of lessons were spent on teaching Communist-Marxist ideology, and therefore, instructing of nursing philosophy and communication skills were neglected of the curricula, not to mention mercy (Kõrran et al., 2008).

In the 1980s, the health care system in the Baltic region was very underdeveloped in comparison to Western standards. There was a shortage of workers, medicines and equipment. The ratio of hospital beds to patients was disproportionate. There was a lack of nurses and paramedics. The polyclinics were staffed by elderly employees with poor professional training. Younger staff were concentrated in hospitals. (Healy & McKee, 1997). In rural areas, primary care was provided by *feldshers* who performed preventive, diagnostic, and therapeutic functions, prescribed medications, and performed some administrative functions (Karanikolos et al., 2014).

The "new period of awakening" started under Gorbachev's *perestroika* and *glasnost* (1985–1991), beginning a process of democratisation. By 1989, only 61% of Estonia's inhabitants were ethnic Estonians. Intellectuals and rural people were the guardians of Estonian traditions and culture and those who contradicted Soviet policies and practices. In the years 1988 and 1989, the intellectuals emerged on the political arena during the "singing revolution" (Estonian nationalist songs used as a form of protest during student marches in several cities). (Tulva, 1997).

The deterioration of the health of the people of the Soviet republics became visible in the second half of the 1980s, and after the sharp collapse of the Soviet Union, signs of deterioration of health indicators were further observed (Roberts, Karanikolos & Rechel, 2014).

The 50-year occupation ended with Estonia regaining its independence in 1991. The decision was adopted in coordination with the Estonian Committee at the meeting of the Supreme Council of the Republic of Estonia on 20 August. The period of state-building of the democratic country began.

Characterization of nursing culture patterns

Culture is the set of knowledge, beliefs, ways of thinking, values, norms, symbols, customs, practices and communication acquired through the process of socialisation, and learned, shared and passed on between generations and prevalent among a particular social group, influencing thinking, decisions and activities in a certain pattern or way (Leininger & McFarland, 2002; Douglas et al., 2014). Culture gives a person identity and belonging, it is not static, but varies both between generations and in relations with other cultures (Hemberg & Vilander, 2017).

In the field of healthcare, cultural competence means understanding how social and cultural factors influence patients' health behaviours and beliefs, and how high-quality healthcare services are ensured taking these factors into account (Kaihlanen et al., 2019). Thus, nursing culture has a decisive role in the formation of nursing patterns. These patterns were clearly highlighted through the content analysis of the interviews. Three themes (nature of work, working conditions, relations and communication) emerged, each with three subtopics (table 2). Respondents worked with patients throughout the course of their lives, both children and adults and the elderly.

Nature of work

The work experience of nurses during the Soviet era has been described by 19 nurses and one expert. Respondents eagerly recounted their work, recalled the situations and general impressions of the era. Some respondents were very talkative and expressively specified even the minor details, some gave very generalised answers. Work enthusiasm and working in a good mood were highlighted.

Working as a nurse required different skills to solve problems. It was often necessary to combine quick manual skills with technical thinking, in conditions where there were insufficient tools. Blood transfusion systems were self-made and needles were sharpened by nurses. Even cottonwool was in short supply, not to mention other equipment.

The difficulties were to overcome, the common goal united the medical staff. Free over-hours were often needed to finish the job assignments. The nurses had to be ready to serve in the army, they were conscripts in reserve.

After the end of the day shift, the nurse was usually alone in a night shift and was responsible for the patients. „*The nurse had to decide when intervention or medical attention was needed.*" (12N65, 10)

One respondent recalled with generosity contact with nurses educated in the pre-war Republic of Estonia. "*In the operating room there were all the older workers, many of them were single because they spent so much time at work that they had no privacy or free time – real sisters of mercy in my opinion… but then this generation was just starting to disappear, but I still saw them and I was able to be with them – I was the only young person at the time. It happened that way and I was very well accepted by the team.*" (1N72, 23).

The same respondent said that she liked to work as a surgery nurse and to smell the drugs after the operation. „*I was a big fan, when I went to the bakery or somewhere after work, I immediately understood why everyone was turning their heads, because I smelled of aether.*" (1N72, 23).

The peculiarities of the era. In describing the work during the Soviet era, the circumstances and situations characteristic of that era could not be ignored.

In Soviet times, hospitals did not yet have computers, so everything was documented on paper, usually by hand. The hospital had paper medical records, including paper order sheets that the nurses filled out on a daily basis. „*The main tool was an order sheet, where the doctor wrote down all the procedures he considered necessary with this patient, and that's how the nurse worked.*" (7N57, 5).

The Soviet era was characterised by professional competitions between workers (professional skills were assessed) and "socialist competitions" between collectives. "*Professional competitions were organised within the institution as well as nationwide. Socialist competitions between institutions were also organized. The winner received a red flag, which*

travelled to the next winner the following year. There were a lot of requirements to be met, a major book detailing the achievements to be presented to the commission." (20E83, 34).

Civil protection trainings were organised every year within the institutions as well as by districts. "*Each health care institution was assigned its own area, which had to be managed in the event of danger. It was also known where the hospital had to be evacuated. There was a person in charge at the health care institution who drew up training plans, which were approved by a higher organisation. The procedure was strict. There was a corresponding person in the Ministry of Health Care who was engaged in civil protection in the Republic.*" (20E83, 34).

Application of ideology in nursing practice. The nurses resented in the interviews the pressure of the Communist Party and the psychological terror that could follow. "*The proportion between Estonians and Russians in the work team also had to be in favour of the Russians. Membership of the party was required, and the working language of many health care institutions was Russian.*" (20E83, 34).

Ensuring a high percentage of female employment was an important part of Soviet ideology. Nurses also worked in nurseries, as nurseries were considered health care institutions. This directed women to work early after giving birth. Propaganda messages such as "kindergarten liberates mother" were followed. The interviews demonstrate that during the Soviet era, the family was secondary, the mother had to go to work when the child was only 2 months old. The nurses and educators kept the children in the nursery, many used the opportunity to work in the nursery to be with their own children. During the Soviet era, there were many 24-hour nurseries and kindergartens where children stayed all week.

„*Working in the nursery was strictly regulated. The nurses had their own responsibilities, the educators had other duties, and the children's time was arranged according to a strict daily schedule. There was very little child-centredness in the system itself. It was thought that a child could do well alone, it was enough to have warm food, clean clothes, toys and supervision, and a roof over his head. The nursery groups were large - up to 32 children per group. Nurses and educators were not able to consider the individual needs of each child.*" (12N65, 10).

All the training of nurses was subject to ideological principles. „*The curriculum did not include such topics as ethics, communication, teamwork, or nursing philosophy. There was no term for „nursing" at all. Not to mention its content. Nor was there a subject of psychology, in the modern understanding of person as a whole: mind, soul, and body.*" (20E83, 34).

Acknowledgement of work and reputation. Living on a nurse's salary was a major challenge, because of that most nurses worked at double load, preferring to work on weekends and at night when wages were higher. „*Additional pay was also included in the cases of an increased health risk, such as radiation, as well as exposure to various diseases such as tuberculosis, leprosy and mental illness.*" (1N72, 23).

Society's attitude towards nurses and the image of the nurses' profession was not high during the Soviet era. "*There was lack of recognition if you weren't recognised by the party line or participated in trade union work*". (20E83, 34).

Working conditions

Based on the analysis of the interviews, working conditions of the nurses were quite poor. Many remembered the large crowded wards, the poor hygiene conditions for the patients, and the heavy physical workload.

„*Working in a children's hospital, I remember that the wards were big and there were children with special needs, with whom I, as a young nurse, had no knowledge or experience. I worked based on intuition. I had never seen unhealthy impaired children in my life, because during the Soviet era, often everyone who was not in normal development, was hidden somewhere in a care home. The TV also did not show such people. I especially remember this embarrassment.*" (8N55, 4).

„*Much of the nurse's time, which could have been dedicated on patients, was spent on washing, cleaning and sterilising medical equipment, as well as cleaning the treatment room. The parents, when they were with the children, were forced to mop the floors and distribute food, as there was a constant shortage of staff.*" (15N63, 9).

There was also often a lack of knowledge on how to manage scarce resources in difficult situations. „*We had to make decisions based on the little knowledge we had.*" (14N56, 4).

At night, there was usually one nurse per hospital department, the standard department had up to 60 patients. "*There were 4 nurses during the day, about 15 patients for each nurse, the night nurses worked alone for 60 patients.*" (16N70, 18).

Working environment. The interviewees remembered that the hospitals were in large old houses with large windows and huge wards, dark wall paint, an unpleasant and ubiquitous smell of chlorine. Treatments were rudimentary and lacked appropriate equipment and medications. Many procedures were performed under local anaesthesia with little effect.

„I worked in the traumatology department of a large hospital, where some patients were treated for several months. The working conditions of the nurses were poor: there were no diapers in the hospital, the tap water was cold. The wards had Soviet-era iron beds that could not be moved and were uncomfortable to sleep in and there were no disposable sheets.“ (13N62, 9).

The specificity of the tools. In the 1960s, most of the equipment was lacking, disposable sterile material was not available, so sterile material and equipment had to be constantly added on site. Many blood transfusions were performed in hospitals and the necessary drip systems were made on-spot. Existing reusable equipment had to be thoroughly cleaned, maintained and sterilised. It was the work of the nurses and it was time-consuming.

There were few rubber gloves and they had to be used sparingly to last a long time. *„We put on the gloves – when the hole came in, the talc started to come out during the operation and went to the wound – then the nurse immediately pulled a new glove on the surgeon's broken glove.“* (12N65, 10).

„At the beginning of the Soviet era, there were no cannulas and disposable blood transfusion systems for several decades. The needles were used repeatedly, in the meantime they became blunt. Then they were sharpened on grindstone.“ (1N72, 23).

During the Soviet era, catgut was used as a suture in wound dressings. It was not sent to hospitals in its finished form, the nurses had to prepare it for several weeks, they had to know the appropriate technology in order to finally get high-quality material. *„As a surgical nurse, I prepared a catgut, which is a sheep's intestine, natural, melts. Its preparation lasted 3 weeks. At first it was in iodine and after that it must have been in 95 degree spirits.“* (1N72, 23).

Even plaster bandages were made while working in the department. *„In the surgery department, for example, in Soviet times, my fingers worked all the time, everyone sat and worked.“* (1N72, 23).

Work responsibilities. Nurses often worked more than 1.0 workload. It was tiring both mentally and physically. In some hospitals, the workload was shared equally, all with 1.5 places, or 240 hours per month. *„Mostly, there were 24-hours shifts in hospitals, sometimes even longer. Short shifts, 8 or 12 hours, were not preferred.“* (17N68, 14).

In the winter during the illnesses of other employees, there was no additional labour available anywhere, hence it also happened that there was a single nurse responsible for several departments during her night shift.

„During influenza outbreaks the nurses in the reception room had to be replaced. This meant that on the ground floor there was one nurse responsible for three departments, running from one end of the house to the other, and occasionally went to the reception room to admit new patients – to make steam to the laryngitis patients ... and everything had to be under control.” (18N64, 5).

In the sixties and seventies, there was a great obligation to prepare the material. This extended the working time up to 2 hours, for which no extra charge was paid. *„I didn't go to work earlier, but I couldn't finish my job in time for the evening. There was a lot of work, working days often lasted longer… in short, 2 hours over the working day we continued often and we didn't complain“*. (1N72, 23).

Nurses who could type, did type audio recordings of operations or annual reports at the office as additional work. *„I was in the hospital's office for about 3 weeks each year and typed voluminous annual reports.“* (1N72, 23).

In the 1960s, dangerous, boiler-heated devices were used to sterilise medical materials. In order to use and regulate them safely, the nurses also had to acquire the using skills of a heater.

„Well, and then I finished these... heater courses... Because the nurse prepared the surgery material for sterilisation… So I could autoclave, sterilise the surgery material: sheets, clothes, gloves, everything.“ (1N72, 23).

Intramuscular injections began to be widely used in the 1980s, and various inflammations were treated with antibiotics. Dissolving them and maintaining and sterilising the syringes was the daily responsibility of the nurses. *„In the morning, antibiotics were dissolved, glass syringes and drip infusions were prepared. After the procedures, the syringes were soaked, washed and sterilised. Before ending the shift, the treatment room and floor were cleaned, the waste was taken out and then the shift was finished.”* (3N56, 3).

Relations and communication

The interviews show that control and physical health were primary, and the patient's feelings and experiences during the treatment procedures were secondary. Procedures were often performed without explanation. *„Children often experienced physical pain, involuntary medication, carelessness, indifference, and rejection in the hospital. Sadness, longing for home,*

feeling pain, crying, feeling boredom and loneliness did not fit in with the Soviet-era image of a happy childhood that prevailed in the Soviet Union." (11N59, 6).

Professional communication was strictly hierarchical. „*In the society of that time, doctors considered nurses to keep their orders. There was a clear hierarchy in health care, much like in the military.*" (20E83, 34).

The peculiarity of the work culture. Work culture has been characterised by respondents through describing uniforms, job satisfaction and joint events of the work team. All nurses had to wear uniforms. From the 1960s to the 1970s there was either an overall or a dress and an apron, and later there was permission to wear trouser suits. The headwear, under which the hair was hidden, must have been worn. "*It was good to be able to wear an open headwear instead of a cap."* (3N56, 3).

Properly chosen profession and job satisfaction were the driving force in life. It was very encouraging to hear the words of a nurse who has worked as a nurse for 52 years (23 of them during the Soviet time) and has maintained a happy mind and satisfaction with her choice of profession. „*I have really been excited with my work and life. It is really very important that You are satisfied with your learned profession – so in the end, everything is fine for me."* (1N72, 23).

The nurses have positive memories of the team's joint events, which can be considered part of the work culture. *"One of the most fun events was the Leninist Saturday cleaning campaign, which the whole team had to participate. It usually ended with a party in the department.*" (15N63, 9).

"There were many happy joint events both in hospitals and nationwide. Nurses from all over the country gathered in the summer camps of the Nurses' Association, also together with their families." (20E83, 34).

Communication with colleagues. Respondents remembered the way tasks were divided. The chief nurse prepared work schedules, checked the nurses' work and, if necessary, gave additional tasks. „*The chief nurse was a very respected and important person in the department, she could not be argued with. She drew up work schedules. Personal wishes were not taken into account there.*" (2N55, 3).

According to the respondents, doctors made most of the decisions and they were treated with respect. „*The nurse was a doctor's assistant and was treated as such, she had no decision-making rights. For example, at receptions at the polyclinic, the nurse prepared the office, invited the patients into the room. The nurse often prepared for the doctor both the necessary equipment and the overall and helped the overall on. The situation in the hospitals was a little better. The nurses visited patients with the doctor and received their instructions from the doctor during the visit. Nothing could be decided on its own.*" (20E83, 34).

The communication between the nurses was good. "*The nurses have always managed well with each other. The chief nurse was honoured. When she came to visit, the nurses stood up to talk. There was a strict subordination and it was respected. What was good – the nurses were always cohesive.*" (20E83, 34).

Sharing information with patients. No empathy or compassion was expected from the nurses, control over the exact execution of orders and commands was considered more important. At the same children's hospital, it was possible that a nurse who traumatised the children with her severity could be at work, as well as a gentle and maternal nurse, who left warm memories for the children. Patients were confident in the doctors and believed only what they heard from them. Therefore, the nurses did not provide the necessary information to the patients.

„*The nurses mainly performed procedures, measured blood sugar and so on… and we did not share much information with patients."* (14N56, 4). "*Patients were happy to share their concerns with the nurses when the nurses had time to listen. But only the doctors were trusted."* (20E83, 34).

Discussion and conclusions

The Soviet regime lowered and ruined the nursing culture what had been constantly developed during the pre-war Republic of Estonia. During the Soviet era, the training of nurses changed significantly (Odiņa, 2013), the previously established training system for nurses was demolished. The changes were introduced in norms of behaviour, attitudes, principles of being a nurse and a responsible person. The whole system of values as a symbolic capital (Bourdieu, 2003) combined the education and behavioural culture that nurses had to embrace and follow.

This left a deep mark on the nurse's reputation. The nurses monitored the treatment on a daily basis, but there was no time to communicate with the patients. No empathy was expected from the nurses, the exact execution of the orders was more appreciated (Ernits et al., 2019b). As communication psychology and the nursing philosophy were replaced by political ideology in

the training of nurses (Kalnins et al., 2001), patients who lacked the usual supportive conversation, suffered the most.

Based on the nurses' experiences outlined above, cleaning, sterilisation and preparation of equipment took considerable time of nurses' shift. The nursing profession was not well paid by the state, and the nurses had to constantly look for extra jobs.

During the Soviet era, medicine lacked all tools, personal protective and medical equipment. This was the situation offered by the Soviet-era space of possibilities (Bourdieu, 2003). However, the work assignments were performed with enthusiasm and good mood. The nurses' work also needed the manual skills of other fields, such as a typist, craftsman, etc. Working as a nurse required problem solving skills, too. After the day shift, the nurse was usually alone in her night shift and was responsible for the patients. It was often necessary to combine quick manual skilfulness with technical thinking, in conditions where there were insufficient tools. The responsibility of nurses is characterised by the quote: „*the Soviet nurse was able and knew everything.*" (1N72, 23).

The difficulties were to overcome, the common goal, the treatment, united the medical staff. At the same time, doctors and the chief nurse were always more important than ward nurses in the employment relationship. Suppression and hierarchy were inherent to this period.

Centralisation of Soviet authorities had a deep impact on health care system. State surveillance and control in health care was characteristic of the Soviet period. Social policies were paternalistic and depended on the policies of the communist regime. The state role in social policy grew, while that of local authorities and voluntary organisations vanished. Nurses and other health and social care workers were seen as „doctors of society" (Tulva, 1997, p. 112), and such work was done by various human service professionals (doctors, teachers, lawyers, psychologists, and kindergarten teachers).

Nurses played a key role in disseminating Soviet ideology and carrying out reforms (Healy, & McKee, 1997). Nursing is part of culture (Leininger & McFarland, 2002) and in this sense, interviews with nurses provide important information about the functioning of society and cultural identity at that time. People's perception of reality is as important as reality itself (Tamm, 2016).

In the 1980s, a gradual liberation began, the ideas of the Western world penetrated through the Iron Curtain, and this gave the opportunity to act more freely and it was possible to start changing the status of nurses for the better again. What happened during the Soviet era affects society today and will continue to do so, but it needs to be reconsidered.

Health care in the Soviet Union was politicised and nursing culture was constructed based on Soviet ideology. This was reflected in the daily work of the nurses. As long as society is changing, and nurses are going to meet and adapt to societies' needs, the nursing culture will also have to change and develop continuously.

Acknowledgment

References
1. Aro, I. (2006). Õendusteaduse osakond 1991–2006. In K. Toode (Ed.), *15 aastat akadeemilist õendusharidust Eestis. Tartu Ülikooli arstiteaduskonna õendusteaduse osakonna juubelikonverentsi kogumik*, 10.10. Tartu.

2. Bauer, M. W. & Gaskell, G. (1999). Towards a Paradigm for Research on Social Representations. *Journal for the Theory of Social Behavior, 29*, 2, 163–185.

3. Birley, J. (2002). Political Abuse of Psychiatry in the Soviet Union and China: A Rough Guide for Bystanders. *Journal of the American Academy of Psychiatry and the Law*, 30(1), 145–147.

4. Bourdieu, P. (1993). *The Field of Cultural Production. Essays on Art and Literature.* Edited and introduced by R. Johnson. Cambridge: Polity Press.

5. Bourdieu, P. (2003). *Praktilised põhjused. Teoteooriast.* Translated by L. Tomasberg. Tallinn: Tänapäev.

6. Braun, V. & Clarke, V. (2012). Thematic analysis. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology, Vol. 2: Research designs: Quantitative, qualitative, neuropsychological, and biological* (pp. 57–71). Washington, DC: American Psychological Association.

7. Braun, V. & Clarke, V. (2019). Thematic analysis. Handbook of Research Methods in Health and Social Sciences. Hoboken, New Jersey*: Springer*, 843–860. http://doi.org/10.1007/978-981-10-5251-4_103

8. Carr, E. H. (1965). *What is history?* Penguin Books.

9. Douglas, M. K., Rosenkoetter, M., Pacquiao, D. F., Callister, L. C., Hattar-Pollara, M., Lauderdale, J., Milstead, J., Nardi, D. & Purnell, L. (2014). Guidelines for implementing culturally competent nursing care. *Journal of Transcultural Nursing: Official Journal of the Transcultural Nursing Society*, 25(2), 109–121. http://doi.org/ 10.1177/1043659614520998

10. Ernits, Ü. (2010). Murrangulised 1990-ndad ja 2010. In Ü. Ernits & A. Sepp (Eds.), *Tallinna Tervishoiu Kõrgkool 1940–2010: Artiklite kogumik*. Tallinn: Tallinna Tervishoiu Kõrgkool, 1–4.

11. Ernits, Ü., Puusepp, K., Kont, K.-R., Tulva, T. (2019a). Development of Estonian nursing profession and nurses' training: Historical, political and social perspectives. *Professional Studies: Theory and Practice*, 5 (20), 9−27. https://svako.lt/uploads/pstp-2019-5-20-2.pdf (21.04.2021)

12. Ernits, Ü., Talvik, M. & Tulva, T. (2019b). Nursing education in the wind of changes: Estonian experience. In *Proceedings of the International Conference on Research in Education, 5.-7.04, Barcelona, Spain*, 1–14. Diamond Scientific Publication. https://www.dpublication.com/wp-content/uploads/2019/05/icreconf-60-174.pdf (21.04.2020)

13. Ernits, Ü.; Talvik, M.; Tulva, T.; Puusepp, K. (2020). Eesti õenduse ja õdede koolituse kujunemisest ühiskonna muutumise tõmbetuultes. In T. Tulva, M. Talvik, K. Puusepp, Ü. Ernits & P. E. Routasalo, (Eds.), *Eesti õendus ajas ja muutumises: Teadus- ja õppemetoodiliste artiklite kogumik,* 16−42. Tallinn: Tallinna Tervishoiu Kõrgkool.

14. Estonian Code of Conduct for Research Integrity, 2017. *Eetikaveeb/ Ethics in Estonia*. Online: https://www.eetika.ee/en/ethics-estonia/estonian-code-conduct-research-integrity (14.04.2021)

15. Gagunova J. (1977). *Haigete põetamine.* Tallinn: Valgus.

16. Healy, J. & McKee, M. (1997). Health Sector Reform in Central and Eastern Europe: The Professional Dimension. *Health Policy and Planning*, 12(4), 286–295.

17. Hemberg, J. A. V. & Vilander, S. (2017). Cultural and communicative competence in the caring relationship with patients from another culture. *Scandinavian Journal of Caring Sciences*, 31(4), 822–829. http://doi.org/: 10.1111/scs.12403

18. Hiio, T. (2012). Haridus- ja teaduskorraldus Eesti NSVs 1940–1991. *Estonica: Entsüklopeedi Eestist.* 01.10. http://www.estonica.org/et/Haridus-_ja_teaduskorraldus_Eesti_NSVs_1940–1991/ (27.05.2021)

19. Kaihlanen, A. M., Hietapakka, L. & Heponiemi, T. (2019). Increasing cultural awareness: qualitative study of nurses' perceptions about cultural competence training. *BMC Nursing*, 18, 38. http://doi.org/: 10.1186/s12912-019-0363-x

20. Kalnins, I. (1995). Pioneers in academia: higher education for nurses in Estonia, Latvia and Lithuania. *Nursing Outlook*, 43, 84–87.

21. Kalnins, I., Barkauskas, V. H. & Šeškevičius, A. (2001). Baccalaureate nursing education development in 2 Baltic countries: Outcomes 10 years after initiation. *Nursing Outlook*, 49(3), 142–147.

22. Karanikolos, M., Kühlbrandt, C. & Richardson, E. (2014). Health workforce. In: Rechel, B., Richardson, E. & McKee, M. (Eds.). *Trends in health care system in the former soviet countries. Observatory Studies Series 35.* (pp. 77–90). Copenhagen: WHO Regional Office for Europe, http://www.euro.who.int/__data/assets/pdf_file/0019/261271/Trends-in-health-systems-in-the-former-Soviet-countries.pdf (16.04.2021)

23. Karjahärm, T. (2010). *Oleviku minevikud. Ajaloolase käsiraamat*. Tln: Argo.

24. Karosas, L. & Riklikienė, O. (2011). Development of the nursing profession in pre-war independent Lithuania (1918–1939): A comparison between past and present. *The Journal Nursing Education, Research, & Practice*, 1, 4–11.

25. Kivimaa, K. (2015). *Naiste rollid ja õigused kui riikliku propaganda osa*. 29.10. https://feministeerium.ee/naiste-rollid-ja-oigused-kui-riikliku-propaganda-osa/ (23.04.2021)

26. Kõrran, T., Onoper, A., Pruuden, E., Roots, E., Ruul-Kasemaa, K., Saluvere, T., Sarv, H. & Õunapuu, M. (2008). *Sammud käänulisel teel: Eesti õenduse arengutest 21. sajandini.* Tartu: Eesti Õdede Liit.

27. Laan, I., Luiga, E. & Tamm, S. (1975). *Lastehaigused*. Tallinn: Valgus.

28. Lagerspetz, M. (2017). *Ühiskonna uurimise meetodid. Sissejuhatus ja väljajuhatus*. Tallinn: TLÜ Kirjastus.

29. Leininger, M. & McFarland, M. R. (2002). *Transcultural Nursing: Concepts. Theories, Research, and Practice.* New York: Mc Graw-Hill.

30. Odiņa, O. (2013) *Development of the nurse profession in Latvia (18th-20th centuries).* Rigas Stradina Universitate. Summary of the Doctoral Thesis.

https://www.rsu.lv/sites/default/files/dissertations/OOdina_Promocijas_darba_kopsavilkums_EN.pdf (23.04.2021)

31. Personal Data Protection Act. (2019). *Riigi Teataja* (RT I, 04.01.2019, 11). https://www.riigiteataja.ee/akt/104012019011 (18.05.2021)

32. Rechel, B. (2014). Public health. In B. Rechel, E. Richardson & M. McKee, (Eds.), *Trends in health care system in the former soviet countries. Observatory Studies Series 35* (pp. 91–110). Copenhagen: WHO Regional Office for Europe, http://www.euro.who.int/__data/assets/pdf_file/0019/261271/Trends-in-health-systems-in-the-former-Soviet-countries.pdf (17.04.2021)

33. Renn, O., & Levine, D. (1991). Credibility and trust in risk communication. In R. E. Kasperson & P. J. M. Stallen (Eds.), Communicating rsks to the public (pp. 175–217). Springer.

34. Roberts, B., Karanikolos, M. & Rechel, B. (2014). Health trends. In B. Rechel, E. Richardson & M. McKee (Eds.), *Trends in health care system in the former soviet countries. Observatory Studies Series 35* (pp. 9–28). Copenhagen: WHO Regional Office for Europe. http://www.euro.who.int/__data/assets/pdf_file/0019/261271/Trends-in-health-systems-in-the-former-Soviet-countries.pdf (16.04.2021)

35. Shiffrin, S. (2000). Paternalism, Unconscionability Doctrine, and Accommodation. *Philosophy and Public Affairs,* 29(3), 205–50.

36. Starks, T. A. (2017). Propagandizing the healthy, bolshevik life in the early USSR. *American Journal of Public Health*, November, 107(11), 1718–1724.

37. Talvik, M., Ernits, Ü. & Tulva, T. (2019). The past is in the future: The challenges of educating Estonian nurses in historical-cultural context. In *Proceedings of International Conference Sustainable Caring for Health and Wellbeing: International Conference Sustainable Caring for Health and Wellbeing,* 1.–3.10.2019. Vaasa, Finland. Abo Academy Press, 46−46.

38. Tamm, M. (2016). *Humanitaarteaduse metodoloogia. Uusi väljavaateid*. Tallinn: TLÜ Kirjastus.

39. Tagaküla, A. & Tammaru, G. (2020). *Nõukogudeaegne õendus narratiivides.* Final Thesis. Tallinn: Tallinn Health Care College.

40. Toliušienė, J. & Peičius,E. (2007). Changes in Nursing Ethics Education in Lithuania. *Nursing Ethics*, 14(6), 753–757.

41. Tulva, T. (1995). *Viron sosiaalityön muotoutuminen murroskaudella*. Akateeminen väitöskirja. Rovaniemi: Lapin Yliopisto.

42. Tulva, T. (1997). Reflections from the Field: Changes in Social Work in Estonia: Transitions in Welfare. *Social Development Issues*, Vol 19(1), 109–121.

PROFESSIONAL STUDIES:
Theory and Practice

2021 / 9 (24)