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SETTING UP A PRODUCTION SIMULATION MODEL IN DOMESTIC LARGE-SCALE PIG PRODUCTION, WITH SPECIAL REFERENCE TO THE METHODOLOGICAL ISSUES OF TEACHING THE PROBLEM AT SECONDARY LEVEL

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1. ANTECEDENTS AND OBJECTIVES OF THE RESEARCH

The most negative impact of the change of regime in the livestock sector was on pig production, with a drastic reduction in production, a sharp drop in the number of animals and difficulties in marketing. The competitiveness and market position of the pig sector has been undermined by a severe shortage of capital, heavy financial burdens and rapid changes in existing structures and ownership. The ability of the sector to adapt to the changed economic and political environment and to follow the development trends in more developed countries of the world has become a crucial issue.

Among the factors of agricultural production, despite technical progress, labour plays a special and specific role. It is also essential to take account of the specific features of agriculture in the training and education of professionals, since agricultural work involves specific working conditions in both livestock and crop production. It is also important to note that agricultural work processes, although largely mechanised, cannot be fully automated. Human intervention in agriculture is essential to the performance of production processes at all levels.

There is a constant demand for professionals with good problem-solving and adaptability skills, who are open to technological and IT innovations. However, few people employed in agriculture in Hungary meet these requirements. I see the solution to this problem - in the light of catching up with international competition - in the introduction of innovative methods of training and teaching, in addition to capital. The current teaching and training methods, mainly at secondary school and vocational school level, are not appropriate in today's competitive environment and are not even suitable for preparing farmers for the new challenges. In recent years, there have been numerous examples of restructuring of the training and education system, mergers of faculties and departments, the abolition and revival of training courses, reorganisation, school integration and centralisation, both at university and at vocational school level. In addition to efforts to change the organisational form, there is also a need to innovate in the pedagogical methods used to train a competitive workforce.

As a result of the high level of development in agriculture, major changes are needed in both teacher training and vocational training. In order to ensure the internationally expected results, it is no longer possible to teach in the same way as before. A major overhaul of secondary agricultural education is needed. One of the areas is the renewal of technical and IT training, the improvement of the quality of practical training in line with technological innovations, and the training of teachers, which is also essential to ensure quality education.

In my thesis I have therefore formulated the following objectives:

- To map the pedagogical methods and the tools that can be associated with these methods used in agricultural technical and vocational schools.
- To identify the set of innovative pedagogical methods and tools that teachers know and use.
- To develop innovative pedagogical methods to develop students' cognitive skills, to develop an economic systems mindset and to encourage them to learn more about the profession.
- Evaluate the effectiveness of the method used and formulate criteria for further improvement.

2. MATERIAL AND METHOD

2.1. METHODS AND OPTICAL INSTRUMENTS USED IN THE SCHOOL OF ENGINEERING

My research questions were primarily aimed at mapping the pedagogical methods used in agricultural vocational schools in the Transdanubian region and the teaching tools needed to implement these methods. The data was collected by means of a questionnaire research method, which I prepared in Google Drive format and sent through the Internet to the seven member institutions of the Transdanubian Agricultural and Vocational Training Centre, which is now a new organisational unit, the Southern Agricultural Vocational Training Centre. As the survey was carried out within the old department, the institutions are listed in the survey under their former names.

Thus, the schools included in the research are:

AM Transdanubian Agricultural Vocational Training Centre, Csapó Dániel Agricultural Secondary School, Technical Secondary School and College,

AM Transdanubian Agricultural Vocational Training Centre, Vépi Agricultural Secondary School, Technical Secondary School and College,

AM DASZK, Sándor Apponyi Sándor Agricultural Secondary School, Secondary School and College,

Agricultural Secondary School, Technical College and Vocational School of Sellye, AM DASZK,

AM DASZK, Vocational School - Zsigmond Móricz Agricultural Secondary School, Secondary School and College, Kaposvár

AM DASZK, Zsigmond Teleki Agricultural Secondary School, Technical College and College.

The survey took place in September 2020 and respondents had three weeks to respond. A total of 70 responses were received from the 86 professional colleagues from the seven member institutions, of which 68 were evaluated and processed and evaluated in a Microsoft Excel spreadsheet. In the questionnaire, first of all, general questions related to the questionnaire were asked. I started by collecting background information on the questionnaire, with questions that defined the respondent's identity (gender, number of years of teaching, qualifications, name of the educational institution). The proportion of teachers who responded to the survey is presented in Table 1.

Table 1
Distribution of respondents by member institution

Name of member institution	Number of teachers	Number of respondents	Male	Female	Distribution of % respondents
Csapó Dániel Member School	13	13	7	6	100
Vépi Vocational Secondary School	20	14	6	8	70
Újhelyi Imre Technical School	12	10	3	7	83,3
Apponyi Sándor Vocational Secondary School	11	11	4	7	100
Sellyei Agricultural School	8	3	1	2	37,5
Móricz Zsigmond Vocational School	14	14	6	8	100
Teleki Zsigmond Member School	9	3	0	3	33,3

Source: Own data collection and editing, 2021

Since I hypothesized that I believe that innovative pedagogical methods based on ICT tools are primarily used by the younger generation, as opposed to the older generation who have been working as teachers for a longer period of time, the time spent teaching is one of the bases of the research. The results are summarized in Table 2.

Table 2
Number of years of education by school

Name of school	1-3 years	4-7 years	8-10 years	11-15 years	16-20 years	21-30 years	31-40 years	41 years over
Csapó Dániel Member School	0	4	0	2	6	1	0	0
Vépi Vocational Secondary School	1	0	2	1	3	4	2	1
Újhelyi Imre Technical School	1	2	2	1	1	1	2	0
Apponyi Sándor Vocational Secondary School	0	4	3	6	0	0	0	0
Sellyei Agricultural School	1	0	0	0	1	1	0	0
Móricz Zsigmond Vocational School	0	5	1	4	1	2	1	0
Teleki Zsigmond Member School	0	1	0	1	1	0	0	0

Source: Own data collection and editing, 2021

All of my respondents have a professional qualification, with the exception of two they also have a teaching qualification.

My questions focused on the traditional and innovative pedagogical methods and working methods that colleagues know and currently use, and the extent to which teachers accept the need to introduce pedagogical innovation.

Questions were also raised about the educational technology tools needed and used to implement pedagogical methods, including the extent to which teachers are aware of the concept of ICT tools, their role in education and their potential use.

In the following, my questions focused on the technological readiness of educational institutions and the equipment of schools with IT tools, as the use of innovative pedagogical methods is increasingly based on the use of ICT tools in the classroom.

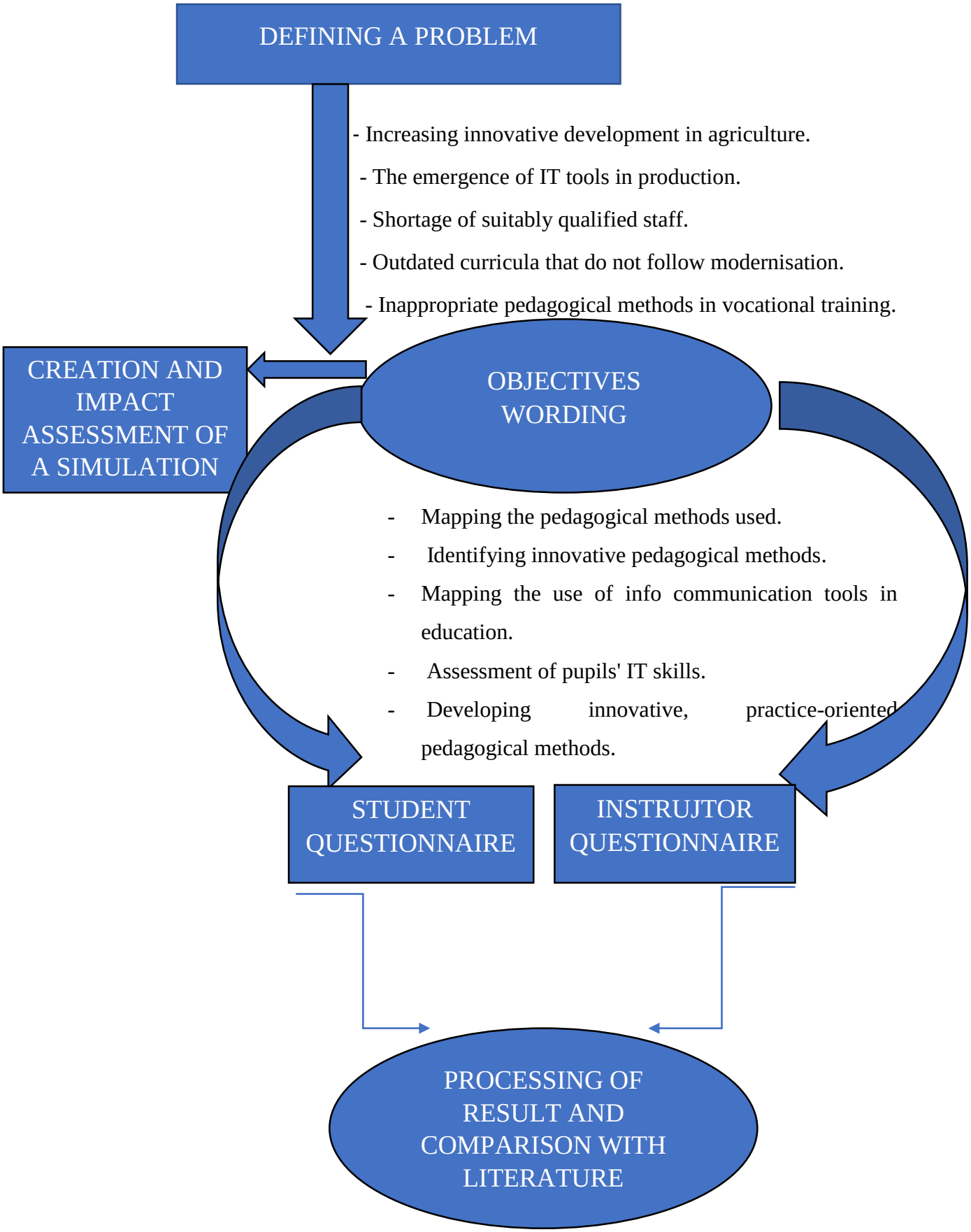
In my opinion, in addition to the implementation of improvements at institutional level, in order to maintain the quality of education, a strong emphasis should be placed on the training of teachers in ICT tools and innovative methods. The emergence of IT tools in schools, based on innovative pedagogy, has made it necessary to train teachers in the appropriate use of ICT tools in the classroom.

The teaching-learning process can only be effective if the technological elements work in harmony with the pedagogical factors, because innovative pedagogical methods and tools can only increase the effectiveness of learning. Otherwise, a decline in student performance may occur.

In the fifth set of questions, I wanted teachers views on the effectiveness of lessons delivered using innovative methods and tools, and on students' attitudes towards and ways of using IT tools. The answers to the questions were organised and analysed using Microsoft Excel.

The students' responses were processed using SPSS, in which the data were analysed not only for significance but also for variance using the statistical method known as ANOVA, which is a method that can analyse the variance and variance of the entire data set as a basic set from the point of view of finding the cause of variation.

2.2. PRESENTATION OF THE RESEARCH MODEL



2.3. PRESENTATION OF THE SIMULATION

As the main objective of pig breeding is meat production, for the economical production of which it is essential to ensure an adequate number and quality of reproduction (Soltész, 2015), I started my investigations by collecting the reproduction indicators of the farm, summarizing the data of the last three years starting from January 2018. The last set of data was recorded in March 2020. During the documentation, 433 farrowings were recorded, in which I included the number of live and stillborn individuals in male and female litters during farrowing, and the number of piglets at the time of choice in relation to sex. The recording of the farrowing data was followed by the sorting of the data sets into MS Excel on the so-called research sheets, individually kept as sows.

After processing the data and statistical tests describing the distributions, a simulation method was developed, based on the Monte Carlo method (MC method). The method is essentially based on random sampling to estimate definite integrals for a large number of samples. In the model to be analysed, the influencing variables and their time intervals, their probability distributions and the relationships between the variables were fixed. I generated real-valued random numbers (1000 of them) between zero and one - assumed to be uniformly distributed - and ran them on a computer with 1000 trial numbers, thus obtaining an expected value for the outcome variable to be determined. The distribution function is used to determine the probability that the value of a given variable will fall within a given interval.

I restricted the model to the total number of piglets born, the number of piglets stillborn and the number of animals that died before the election.

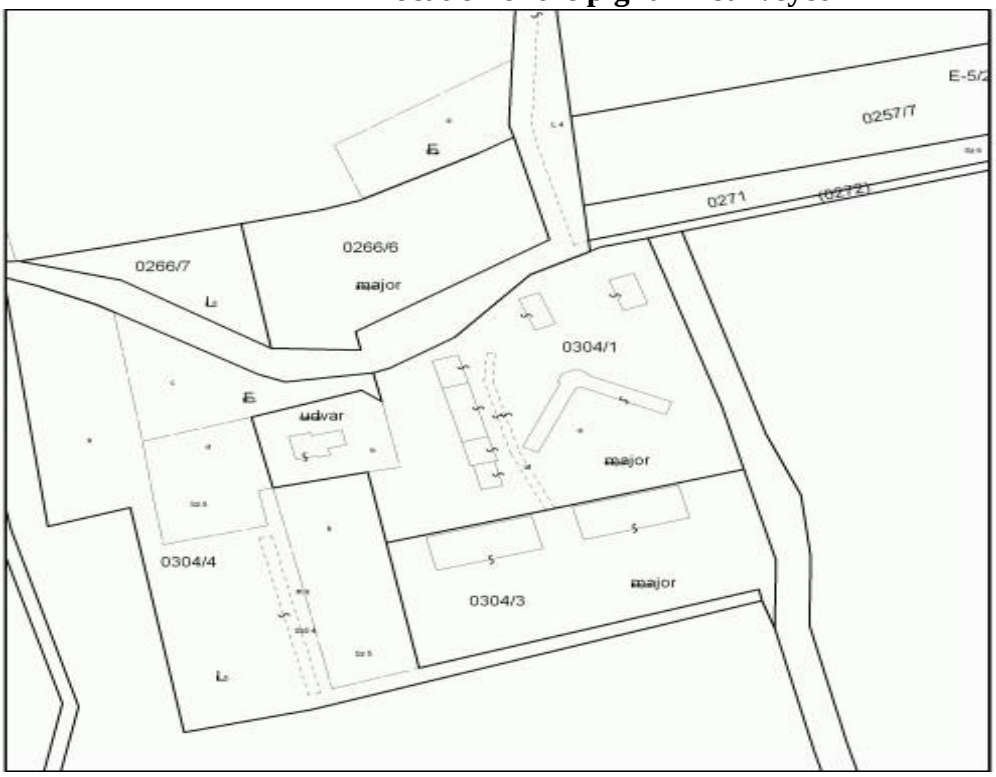
During the simulation, by changing the variables in the simulation data set from 0-1, using the "HA" functions in the simulation, both the distribution function and the elements of the frequency plot are changed, showing the effect of our simulation on the elements of reality. In the simulation result, changes affecting the whole economic process can be "predicted", which can form the basis for some economic calculations, so that even revenue-income relationships can be predicted, but also for ordering a feed base or feed raw material.

3. RESULTS

3.1. INTRODUCTION TO THE TEST FACILITY

The primary objective in selecting the farm to be studied was to match the characteristics of an average large pig farm in Hungary, where neither the technology used nor the breed of pigs produced shows any striking differences compared to the existing farms. The location of the farm, a copy of the land registry map, is shown in Figure 1. Scale 1: 2000 m, parcel number 0304/1.

Picture 1
Location of the pig farm surveyed



Source: Somogy County Government Office, 2021

The plant I am investigating is located in the northern part of Somogy county, which was purchased and renovated by the owner in 1998 with the money won from the Young Gazda competition. It has been operating in this form since 1999 with nearly 65 sows. Their work includes breeding and fattening, so they deal with about 1800-2000 animals per year. The main production indicators are summarised in Table 3.

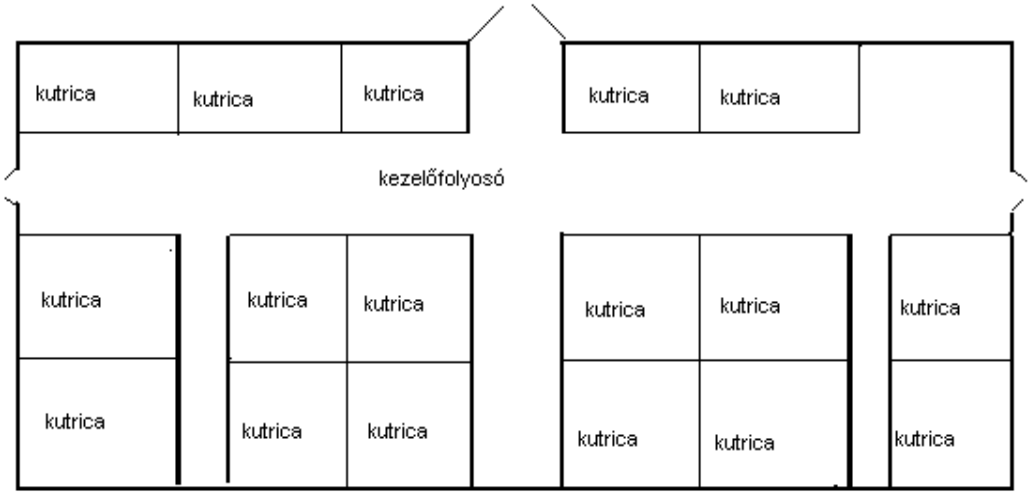
Table 3
Main breeding indicators on the farm 2018-2020

Description	2018	2019	2020
Pregnancy %	85	80	90
Average number of breedings per sow	12,8	13,6	14,5
Weaning average piece/ sow	11	11,4	11,9
Sow rotation piece/ year	2,4	2,4	2,4
Piglet mortality until election %	15,8	16,7	16,8
Sow cull %	30	28	32

Source: Own data collection and editing, 2020

Unfortunately, they do not own their own land, so the fodder base is provided by nearby farming organisations. Soya is purchased from various companies, which they always try to buy at the most optimal price. Currently, Bunge Zrt. is responsible for this task. Adequate supply of amino acids and microelements is ensured by premixes marketed by SANO. A grinding and mixing plant is operated on the site, which is used to produce feeds for the appropriate age groups on the basis of their own recipes.

The structure of the plant includes a building suitable for the separate rearing and handling of each age group.



Drawing 1: The internal layout of the nursery building

Source: Own editing based on Site data, 2021

In the nursery building - shown in drawing 1 - 17 nursery cages were installed. The sows are housed in the farrowing house until the 110th day of their pregnancy. Programmed farrowing is used on the farm, with farrowing on days 114 to 115. The piglets are separated from the sows at 28-30 days of age, at which time both sows and piglets leave the nursery. The nursery is constructed with a 5 % slope on a concrete floor, which is littered with straw. An air restrictor and an infra-red light are placed above the piglets' resting area. The sows are fed individually, with three feedings a day. Dry and dry feed is fed through a metal tube into the trough, which also contains a levelling trough. The piglets are first fed mashed feed at 21 days of age. Drinking water is provided through suckers.

The nursery consists of 2 rooms, with 8-8 pens per room. This is where the piglets are transferred from the nursery and where the farrowing takes place. 1 cutlet provides optimal conditions for 20 piglets up to an average weight of 25 kg. The piglets are initially fed rationed and then continuously fed into the feeder.

The housing for the piglets has been designed so that there are 4 pig pens in each of the two rooms. Piglets weighing between 25 and 30 kg are brought from the nursery and are housed here until they are transported, when they weigh 120 kg. The animals are fed from a so-called wet feeder (the suckers are located in the trough part of the feeder.)

The fattening shed is a brick building with 4 rooms, with 4 pig pens in each hall. The capacity of each pig pen is about 20-22 fatteners weighing 120-125 kg each. Feeding is by a wet feeder built into a partition wall, into which the feed is fed by a two-round automatic disc feeder system.

The sow shed has 16 concrete bases (5% slope) and 4 pens. The inner part of the pens are covered and can be winterized, the outer part is a runway. 1 cutrica can optimally accommodate 3-4 sows. The breeding boars are housed in separate pens. They are fed in these pens according to a measured portion of straw fed the ration is determined by the gestation period. Any sows that are weaned are fed individually.

Breeding takes place in a special room in the paddock, where artificial insemination is also used, with a large proportion of the fertiliser being used by the farm itself and some purchased. The spreading and storage of manure is a major factor in the operation of any pig farm. As straw is used throughout the farm, irrespective of age, and as they do not have their own land, they buy their litter from farmers in the area in exchange for the mature manure, so spreading manure on land used for agriculture is not a problem. Storage in manure silos with concrete bottoms and sides has been arranged according to standards.

In terms of breed, Large white and Landrace pigs, which are bred by KA - HYB continuity crosses. The hybridisation consists of pairing paternal lines with female lines in a specific order, similar to rotational crosses. The crossed generation thus produced is the final product and also the initial maternal base for further crosses (Kovách, 2001).

The site employs a total of 5 people to carry out the day-to-day operations. The owner is also involved in the physical work, but is mainly responsible for tasks requiring more technical knowledge, such as insemination, castration, and the preparation of feed rations. The paperwork, applications, grants and documents are managed by the farm manager, and the physical work is done by 3 employees on a rotating basis.

3.2. A DESCRIPTION OF THE ECONOMIC BACKGROUND OF THE ESTABLISHMENT UNDER STUDY

The revenue of the farm can be divided into two factors, the larger part (70% per year) coming from the sale of porker, and secondly from the sale of piglets, which generates a significant revenue even with less input. The main parameters of the farm are summarised in Table 4.

Table 4

Main breeding indicators for the farm

Description	2018	2019	2020
Average number of cows (head)	60	65	68
Sow rotation	2,4	2,4	2,4
Average rearing %	81	80	80
28-day-old litter			
Average (head)	11	11	12
Piglet average weight (kg)	7,2	6,8	6,7

Source: Own data collection and editing, 2021

The porkers are sold to Kometa 99 Zrt. at current market prices, which after the last period of 500 HUF/kg decreased to 370 HUF/kg due to the re-emergence of African swine fever in the German pig herd. The income situation for the last three years is illustrated in Figure 1. While fattened pigs accounted for 85% of the farm's income in 2018, this had fallen to 81% by 2020, a decrease of around 3-4 percentage points compared to previous years.

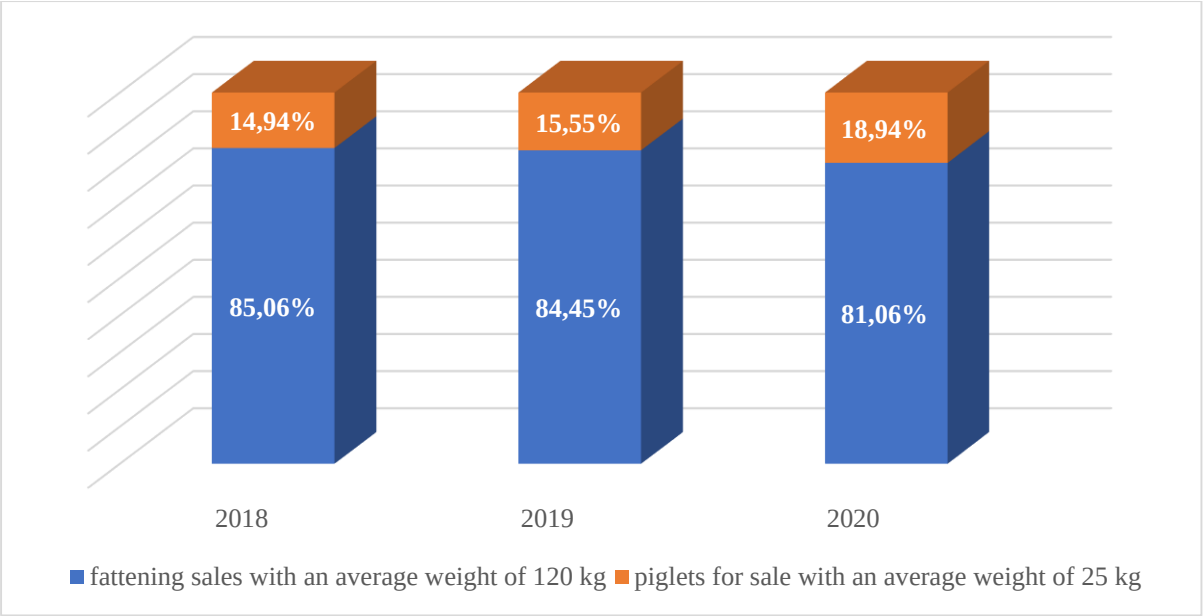


Figure 1

Distribution of turnover in the farm under study

Source: Own data collection and editing, 2021

Among the reasons for the change, we should look at the relationship between piglet and porkers' sales prices. Thirty percent of the stock sold was piglet aged sales, a price that was on average 197% higher than the selling price of fatteners, so that in 2020 it exceeded 254%. Regardless of the shift in the selling price ratios, the farmer achieved a 4.3% profit on porker sales averaged over three years. The piglets are sold to smallholders, of course at current prices. This part of the sector has seen very significant price increases in recent times, as shown in Figure 2.

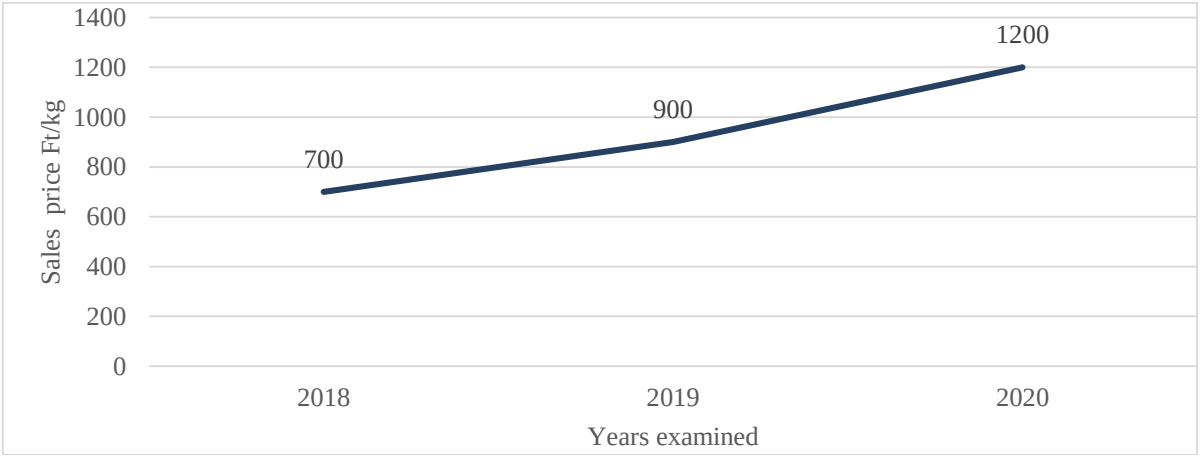


Figure 2

Change in piglet sales prices on the holding under survey

Source: own data collection and editing, 2021

Both sources of income and the annual average of income prices show a steady increase in prices, which offset the increase in production costs, so that profitability levels remained unchanged despite the production conditions. The most important limiting factor for productivity and profitability is the drop-off to the election, which was at its lowest in 2018 but still reached 15.5%. Figure 3 shows mortality to election as a percentage of herd change.

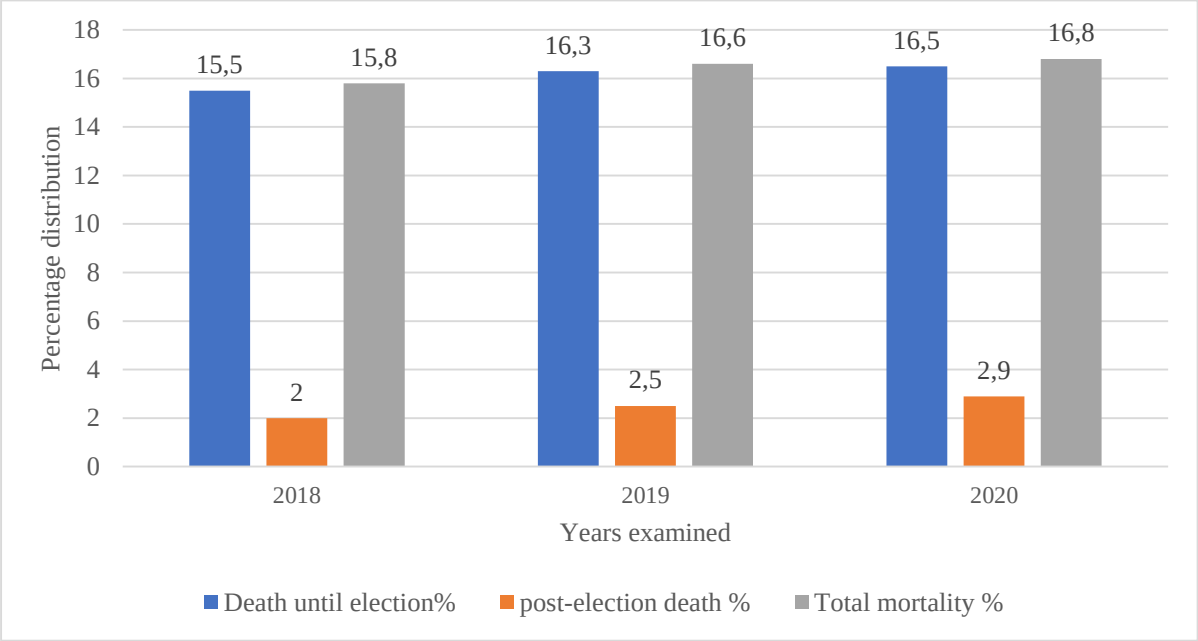


Figure 3

Distribution of deaths in the farm surveyed

Source: Own data collection and editing, 2021

In the last 2-3 years, the number of stillbirths per farrowing has increased on the farm, mainly due to E. coli diseases, lack of body weight and vitality at birth and physical injuries of the piglets. The mortality rate of piglets is normally between 3 % and 4 %, but can be as high as 16 % on this specific farm.

3.3. SIMULATION MODEL OF THE FARM

Before I set up the simulation model for the farm and made the calculations with the results of the model, I compared the recommendations and results with the results of the farm.

Of the reproductive performance indicators of sows, the most important ones are related to reproductive performance, which can be evaluated by the number of farrowings and the number of piglets farrowed.

In order to make pig breeding profitable, sows can be inseminated several times a year, and there is a biological basis for this. To calculate this, the days of the year are divided by the sum of the gestation period, the suckling period and the time from weaning to reweaning, resulting in the sow rotation value, i.e., the index of sow utilisation. Using the data from the farm, the results are summarised in Table 5.

Table 5

Sow rotation calculation based on the data of the surveyed colony

Name	Duration in days	
Breastfeeding period	28	30
Sow gestation	115	115
Time from weaning to reweaning	7	7
Total	150	152
Sow rotation	365:150=2,4	365:152=2,4

Source: Based on data from the farm surveyed (own editing), 2021

The average sow rotation in the European Union so far is 2.2-2.3 /sows/year, which is matched by the 2.4 result for the 28 or 30 days on this specific farm.

However, the average number of piglets born on the farms is lower than expected in the literature, while the average number of piglets born in Western Europe is 16-20, in the farm i studied, this indicator was 13 piglets born alive in 2018, 13.7 in 2019 and 14.4 in 2020.

There is a significant discrepancy between the data from the sites and the indicators reported in the specialized literature, and it is therefore justified to recommend improvements and investments for further effective management. In particular, the introduction of technological innovations and the implementation of species rotation could provide a solution to improve the low reproduction rate.

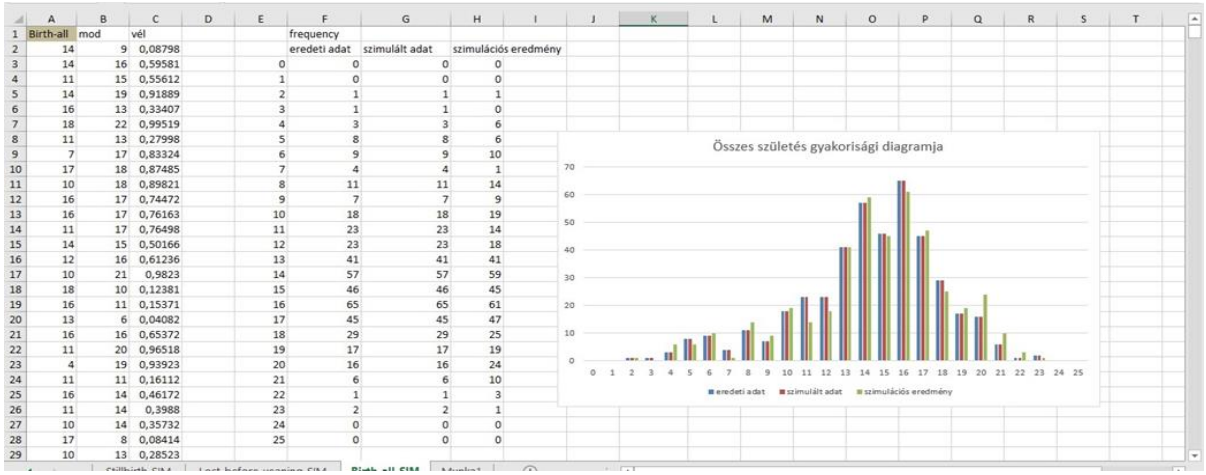
Since changes to the plants consume a significant amount of time and resources, I have set up the simulation on a gradual basis, so I have not set up sudden big changes, but smaller, more feasible, slowly changing processes.

In the second picture, I have recorded the starting position of my simulation, taking into account all the births. The simulation contains the original data - the variations given by the person who performed the simulation and the results of the simulation run by the computer with random values based on the Monte Carlo method. The results of the "MC" simulation method carried out by the computer were largely determined by the constraints imposed by the original data,

since the model to be analysed included a fixed set of influencing variables and their possible intervals, probability distributions and relationships between variables. The given interval and distribution values of the variables are created by a random number generator

Picture 2

Total births frequency chart full data table



	A	B	C	D	E	F	G	H
1	Birth-all	mod	vél			frequency		
2	14	9	0,08798			eredeti adat	szimulált adat	szimulációs eredmény
3	14	16	0,59581		0	0	0	0
4	11	15	0,55612		1	0	0	0
5	14	19	0,91889		2	1	1	1
6	16	13	0,33407		3	1	1	0
7	18	22	0,99519		4	3	3	6
8	11	13	0,27998		5	8	8	6
9	7	17	0,83324		6	9	9	10
10	17	18	0,87485		7	4	4	1
11	10	18	0,89821		8	11	11	14
12	16	17	0,74472		9	7	7	9
13	16	17	0,76163		10	18	18	19
14	11	17	0,76498		11	23	23	14
15	14	15	0,50166		12	23	23	18
16	12	16	0,61236		13	41	41	41
17	10	21	0,9823		14	57	57	59
18	18	10	0,12381		15	46	46	45
19	16	11	0,15371		16	65	65	61
20	13	6	0,04082		17	45	45	47
21	16	16	0,65372		18	29	29	25
22	11	20	0,96518		19	17	17	19
23	4	19	0,93923		20	16	16	24
24	11	11	0,16112		21	6	6	10
25	16	14	0,46172		22	1	1	3
26	11	14	0,3988		23	2	2	1
27	10	14	0,35732		24	0	0	0
28	17	8	0,08414		25	0	0	0
29	10	13	0,28523					

Source: Own data collection and editing, 2021

The birth rate chart shows the number of piglets per farrowing session, i.e., the number of piglets born per sow during the farrowing session, as shown in the bottom row.

The simulation I ran is shown in Figures 4 and 5, where blue is the original data, yellow is the result of the variables I set, and grey is the result of a computer simulation run with random values based on the Monte Carlo method.

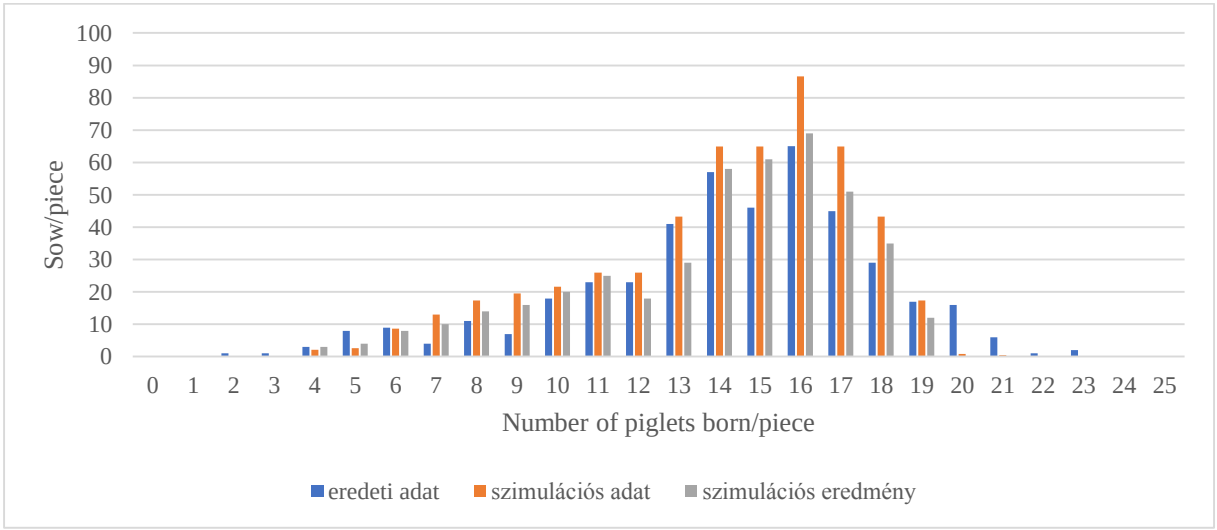


Figure 4

Total births frequency chart

Source: own data collection and editing, 2021

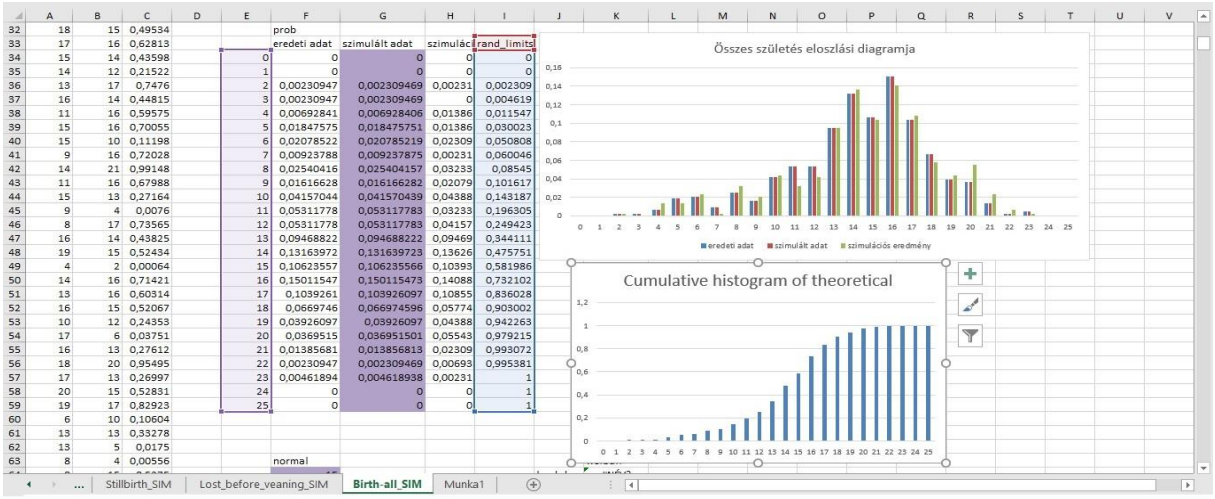
From the results of the picture and the graph, it can be observed that in my simulation (with the original data unchanged and the machine simulation) I reduced the very high (20-25 piglets per farrowing) and the very low (0-3 piglets per farrowing) farrowing numbers to zero. Thus, the results show that in my simulation 87 sows could give birth to 16 piglets per farrowing compared to 65 sows per farrowing in the original data. In the machine simulation, 69 sows achieved this performance. Compared to the original data, the largest increase was in the number of sows farrowing 18 piglets (from 29 to 43 piglets), an increase of 48%, and a significant increase was also observed in the number of sows farrowing 17 piglets (from 45 to 65). Similar changes were observed in the computer simulation "MC". The computer increased the number of sows farrowing 14 and 18 piglets, while it decreased the number of sows farrowing 5,12,19 piglets, taking into account the probability variables.

Comparing the results of the two simulations, we can say that very high and very low failing possibilities were excluded in both simulations, but significant differences in the number of failings assuming higher results are found.

While the frequency diagram shows the number of pigs per piglet, the distribution diagram, or function, shows us the probability of the data in the frequency diagram occurring. In our case, this gives us the probability that the sow will reach the given number of piglets during her farrowing. The recording of the initial condition is shown in Figure 3.

Picture 3

Total births distribution chart full data table



Source: Own data collection and editing, 2021

The figure, which captures a baseline situation is not significantly different from the original situation, shows that the probability data for each birth litter do not show significant differences from each other. The probability variables are close to the original values.

The distribution function for the birth rate obtained from the simulation is shown in Figure 5.

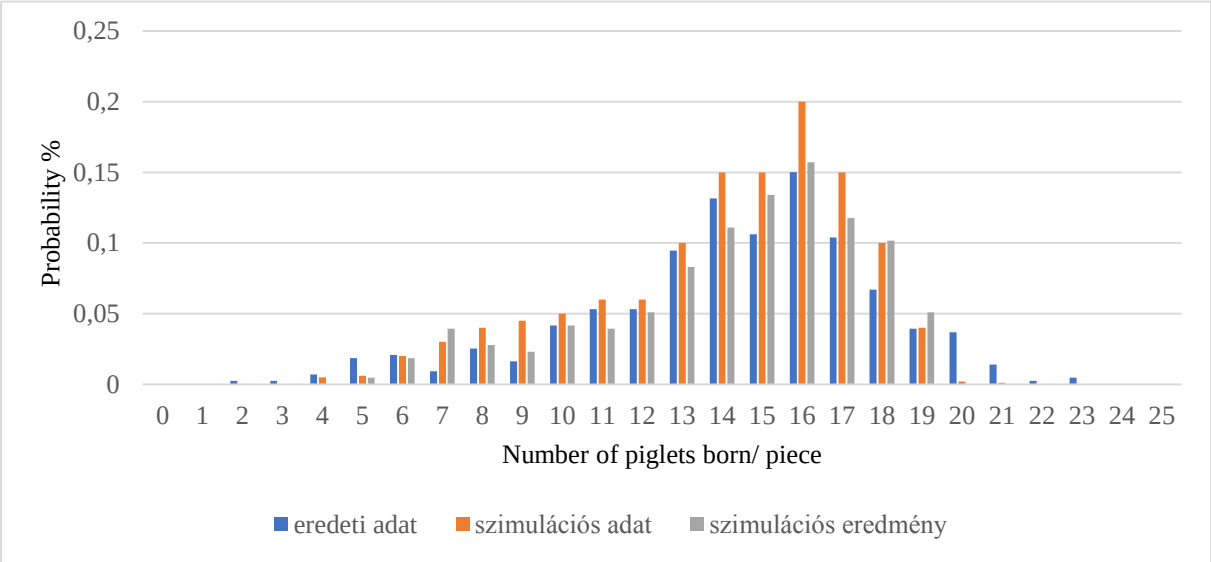


Figure 5

Distribution function of births

Source: Own data collection and editing, 2021

Analysing the data obtained, I would like to highlight the probability distributions associated with the birth of 16 piglets as an example. In the original data series, the frequency number for 16 piglets born is 65, with a probability distribution of 15%. The simulation I have carried out gives the same result for 87 cases, with a 20% chance of this being the case, while in the simulation using the "MC" method, 69 sows reached the number of 16 piglets born at farrowing, with a probability of 16%.

There are significant differences in the results of the distribution function for the number of births when comparing the two simulations. In the process I controlled, there was a larger change (34% and 44%) in the number of sows farrowing 16 and 17 piglets, which represents a 5% increase in the original probability variables. The probability of the same results occurring was only 0.7% and 1.7% different in the machine simulation. Convergence in the two simulations can only be read for the distribution value of sows that foul 18, for which it predicts the same probability of 10% for this outcome to occur, with a 4% difference from the original probability distribution.

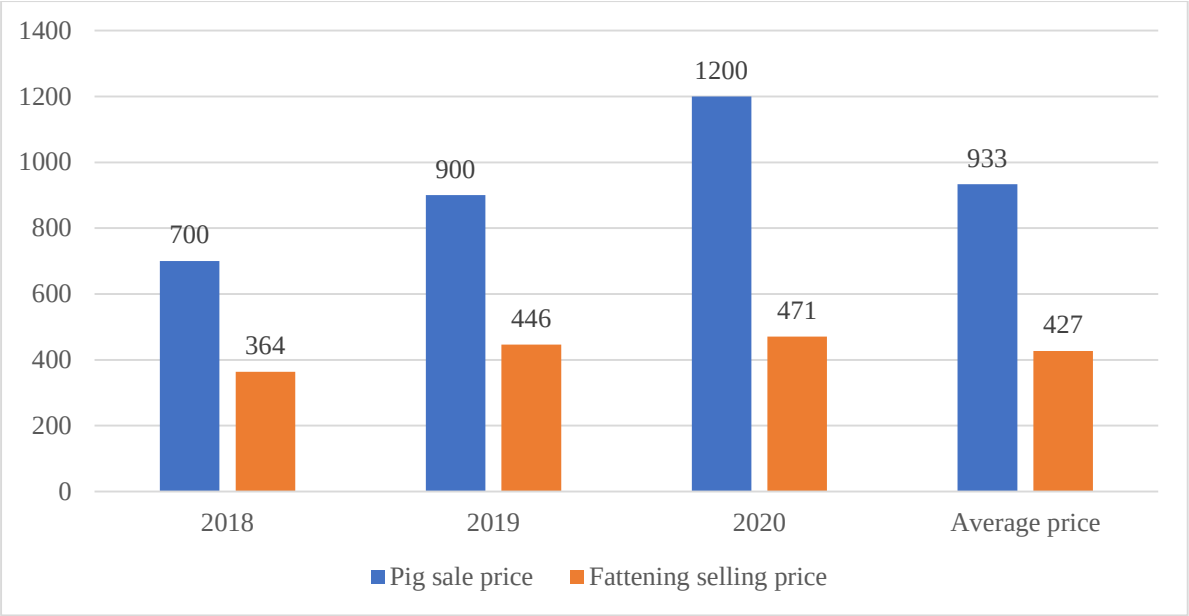


Figure 6

Evolution of sales prices in the economy under review

Source: Based on data from the HCSO and on farm data (own editing), 2021

From an economic point of view, the simulation results show that there is a significant difference in revenue between the two simulations.

In the simulation I have carried out, there is a larger change in the number of piglets - an increase of about 21% - which has an impact on the development of the turnover. Using the data in Figure 6, which shows the change in farm selling prices over the interval 2018-2020, it can be shown that (when calculating the increase in revenue, taking into account that 30% of the stock sold is sold at piglet age) an additional revenue of around £629,000 can be expected from the sale of choice piglets at 25 kg. An additional revenue of HUF 3 279 000 can be forecast from the sale of fatteners at 120 kg, totalling HUF 3 908 000 as a result of the simulation.

It is important to highlight the important differences in the use of the two simulations. In the "MC" method, there is no change in the number of piglets born, as this is determined by the constraints of the original data, so this method is suitable for the distribution of births, possibly to determine birth maxima, and may be useful for the farmer, for example, in the case of synchronised breeding. The simulation I have carried out can also be used to predict changes in the number of births or the distribution of birth numbers over time, if used in a broader context. A economic indicators and results, the aim is to maximise the total number of piglets born while minimising loss items such as the number of piglets stillborn and deaths before election. Therefore, the simulation model had to take into account mortality-related factors. In Figure 7, which shows the distribution of stillborn piglets, the data recorded on the farm are shown in

blue, the result of my simulation is shown in red and the result of the computer simulation using the "MC" method is shown in green.

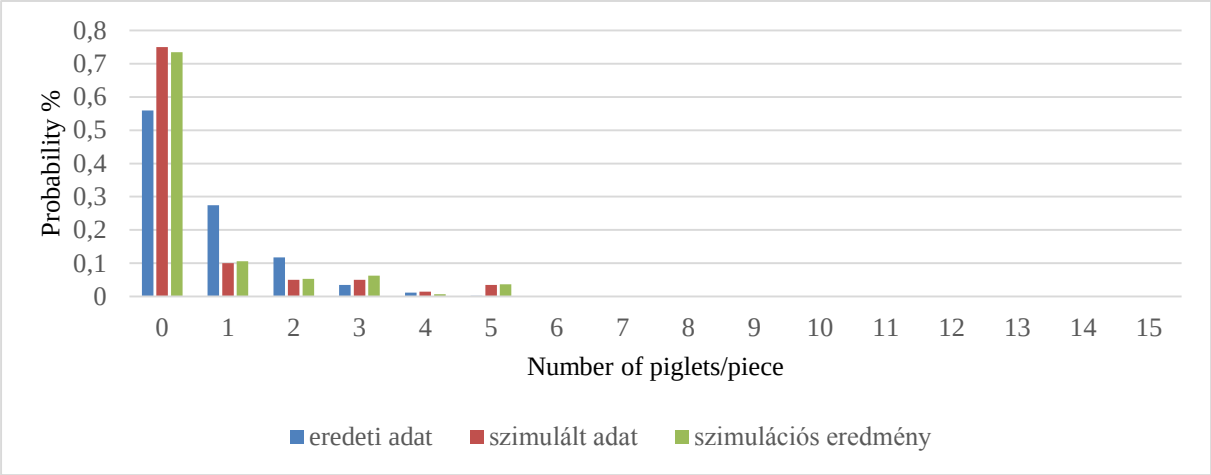


Figure 7

Distribution function of stillborn piglets

Source: Own data collection and editing, 2021

I adjusted the process to give the highest proportion of fouling frequency without mortality (about 20%). I reduced the frequency of one mortality with one mortality by 17% and two mortality with two mortality by 6%. Although the three and five piglet mortality rates increased slightly, the larger increase in the frequency of farrowing without mortality compensated for the resulting loss. The computer simulation using the "MC" method did not differ significantly from my set-up process. For the same values of the two simulations, the deviation ranged from 0.1% to 0.5%.

The high proportion of stillborn piglets is clearly an accurate indicator of animal health shortcomings. Failure to comply with vaccination and health regulations and rules can result in serious losses for the farmer. In our case, a regular vaccination programme on the farm, with compliance to animal health regulations, keeps the stillbirth rate at a 4% loss level.

The frequency plot for the distribution function is shown in Figure 8.

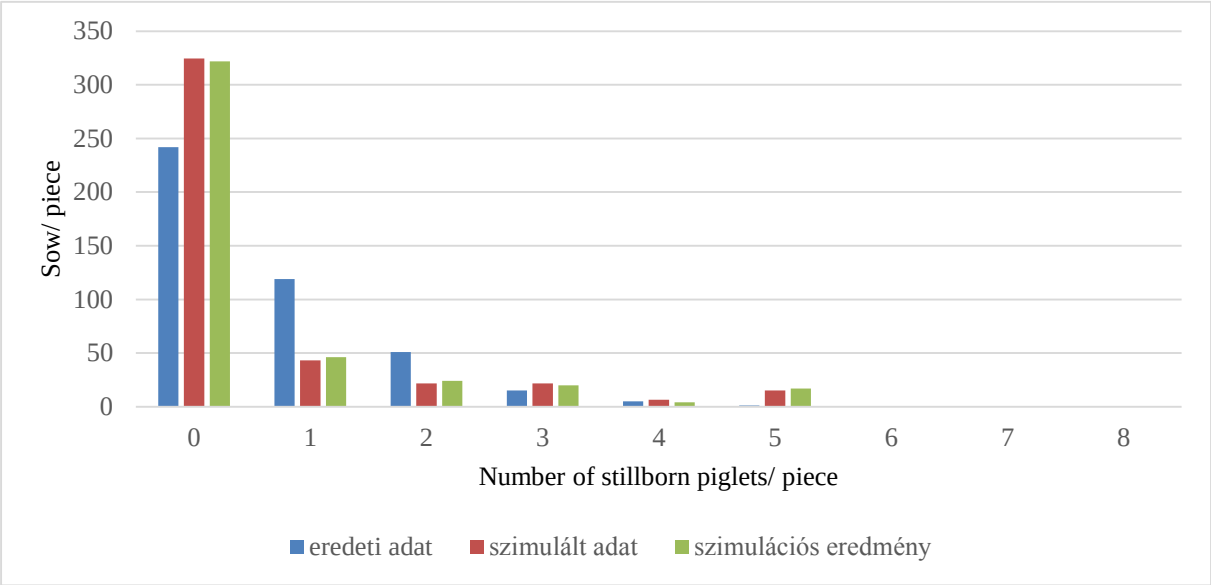


Figure 8

Frequency diagram of stillborn piglets

Source: Own data collection and editing, 2021

The graph shows that in 242 cases, no stillbirths were observed during the birth. In my simulation I increased this figure by 34%, so that the number of farrowings in which no stillbirths were observed was 325. The reduction in the number of stillbirths, in the condition assuming one and two case numbers, was 63% and 56% respectively in the simulation I performed, and 61% and 53% respectively in the computer simulation based on the "MC" method. The only other striking change in the number of piglets is the one for the condition assuming five case numbers, where there is a 90% increase, but only 1% of all farrowings, which represents a loss of 4%.

Neither my simulation, nor the simulation run with the "MC" method, revealed any extreme case, which, if changed, would lead to a more significant result in the operation and economic situation of the plant.

Further data and simulation results show significant differences in pre-election mortality. While in the literature a mortality rate of 2-6% is considered to be average, in the farms I studied it exceeded 16%, which is a very high rate, with the spread of physical injuries due to technological deficiencies and bacterial diseases playing a leading role.

The values for the pre-election mortality simulation are illustrated in Figure 9. It can be observed that, according to the percentage distribution for the original data set, there is a 30% probability that no deaths occur before the election, while 28% have one death, 20% have two and 12% have three. From the simulation data I have provided, it can be deduced that there is a 75% chance of no mortality and a 15% chance of only one mortality, a 10% chance of two

mortalities and a 7% chance of three mortalities. Based on the results of the computer simulation run using the "MC" method, 67% assume zero mortality, 12% assume one mortality, 7% assume two mortality and 5% assume three mortalities. The probability of five or more mortalities occurring in both simulations is 2% or very close to it.

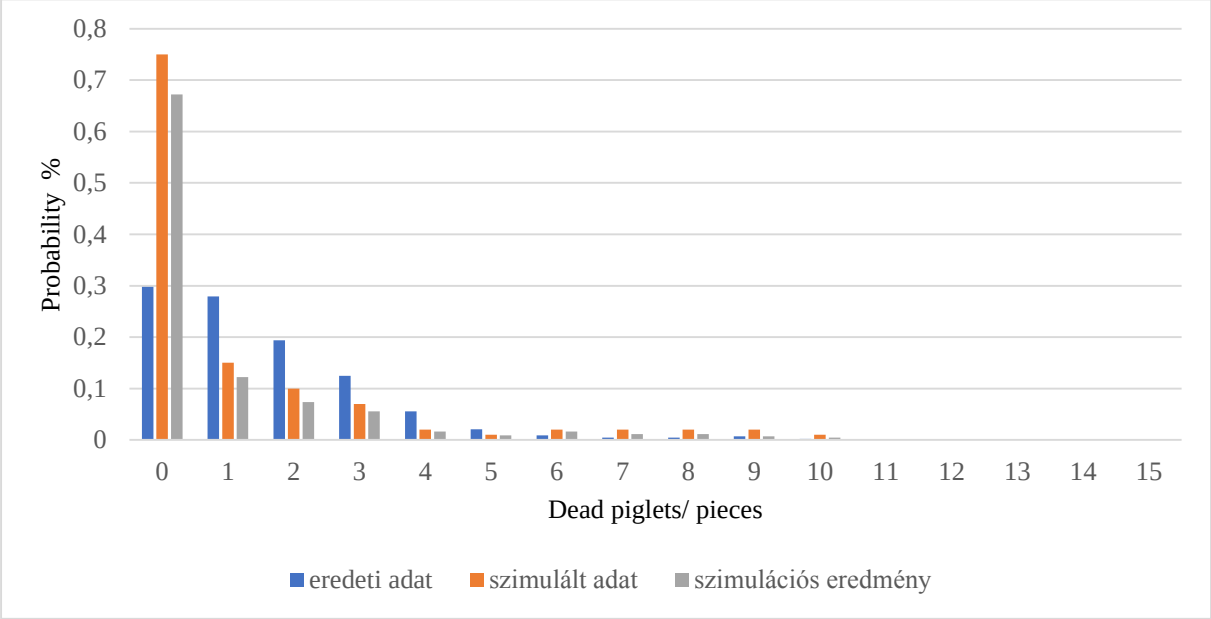


Figure 9

Distribution function of pre-election mortality

Source: Own data collection and editing, 2021

A mortality diagram of the pre-election frequency is shown in Figure 10, which presents a numerical mapping of each option. Zero mortality occurred in 129 cases in the original data set, 121 cases where one animal died were recorded, 84 sows had 2 piglets and 54 animals had 3 fewer than 3 piglets. The simulated value under my conditions assumes 325 cases with no mortality, 65 sows with 1 piglet loss, 43 sows with 3 piglet losses, 30 cases with 3 piglet losses before selection, which results can be achieved by changing technology, modernising farrowing systems and reducing diarrhoea-causing bacteria.

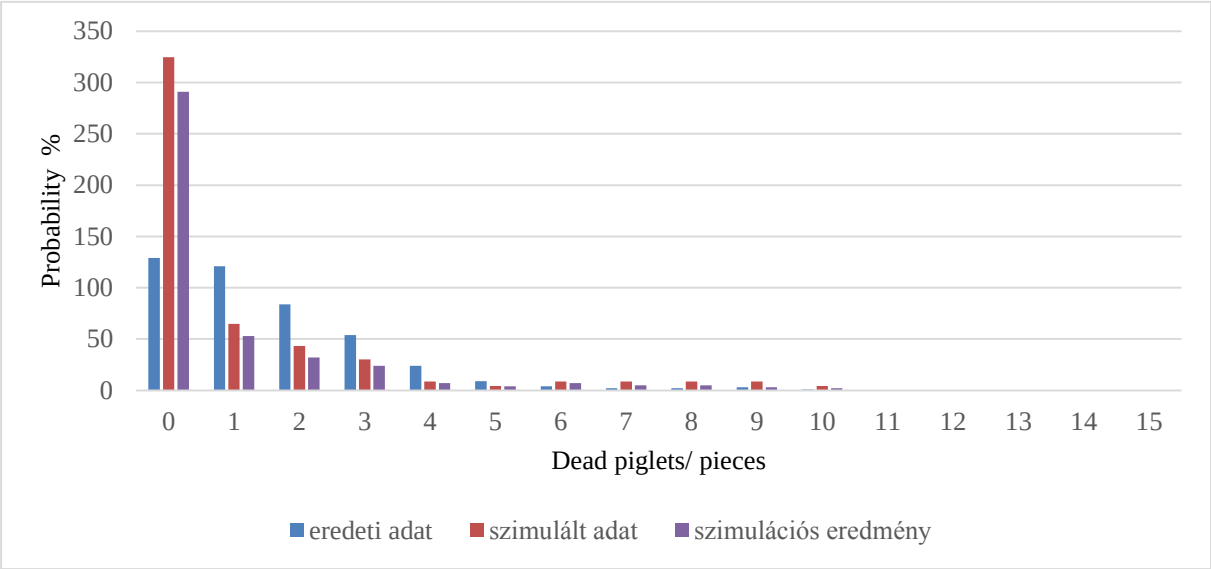


Figure 10

Pre-election mortality frequency diagram

Source: Own data collection and editing, 2021

The simulation model output assumes 291 cases with no mortality, 53 cases with one mortality, 32 cases with two mortality, and 24 cases with three mortalities in the pre-election time interval. Comparing the two simulations, it can also be highlighted that the "MC" method did not change the number of piglets that died before the choice, as it is constrained by the original data, and is only suitable for determining distributions over time. In the simulation I performed, the number of piglets at selection increased by 19% compared to both the original data and the simulation performed with the "MC" method. Compared to the average of the three years, this would mean an additional sale of about 925 animals, during which the farmer can expect a significant increase in turnover.

The reason for the high mortality rate before the election is mainly due to technological deficiencies and poorer piglet rearing ability, as evidenced by the fact that the causes of piglet deaths in the farms I studied were mainly due to crushing and trampling, which can be avoided by proper cuticle design and by the removal of nervous, difficult-to-handle sows. About 15% of the piglets died as a result of infection caused by the diarrhoea-causing bacterium E. coli, a smaller proportion (10%) died as a result of low birth weight and 2% died as a result of physical injuries.

The pillar of economic production is to maximise the number of piglets born and weaned and keep mortality to a minimum. Taking into account the technological equipment, economic indicators and simulation results of the farm under study, it can be said that major investments,

such as the modernisation of the farrowing crates, the possible change of breeds or the introduction of new animal health innovations, can lead to a significant increase in turnover. By reducing the 16% selection loss and the number of stillborn piglets, the 21% increase in the number of piglets seen in the simulation results could be achieved, which, taking into account the average sales prices shown in Figure 6, could result in an additional turnover of more than 10 000 000 HUF /year.

3.4. METHODS AND TEACHING TOOLS USED IN AGRICULTURAL VOCATIONAL SCHOOLS

I limited the survey to colleagues who are involved in professional training as teachers or theoretical teachers. Some of the respondents have been working in this field for only one year, others for over 42 years as a recognised teacher.

All have professional tertiary and teaching qualifications. The questionnaire received 70 responses, of which 68 were processed. The answers to the questions are presented in Tables 6 and 7 and in the graphs in Figure 11 - Figure 38. In the next step, let's review the key findings of the questionnaire survey. My starting question was how many of the respondents use traditional pedagogical methods in their education. The result obtained is shown in Figure 11.

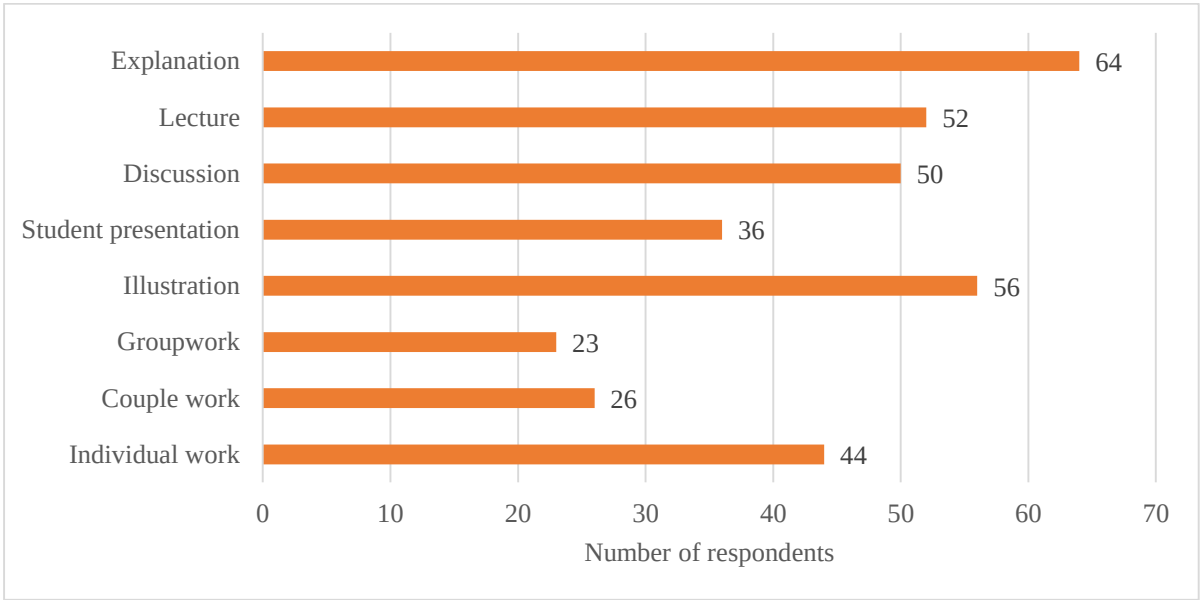


Figure 11

The use of traditional pedagogical methods in agricultural education

Source: Own data collection and editing, 2020

As we have read in the literature review, several educational researchers (Falus, 2001 Petriné, 2001, Radnóti, 2006) have emphasised that traditional teaching methods are dominant, such as individual work, presentation, demonstration, explanation, discussion, practice. In the survey I conducted, explanation was also the most frequently used method, followed by demonstration and lecture. The distinction between the teacher and the pupil is important when it comes to the presentation, as the latter can be seen as an innovative pedagogical method, where the teacher acts as a facilitator in the lesson, but as the graph shows, the pupil's small lecture is overshadowed by the pair and group work.

In addition to the use of traditional working methods, the next steps have focused on the use of new generation methods and tools. The methods are summarised in Figure 12 and the use of teaching tools in Figure 16.

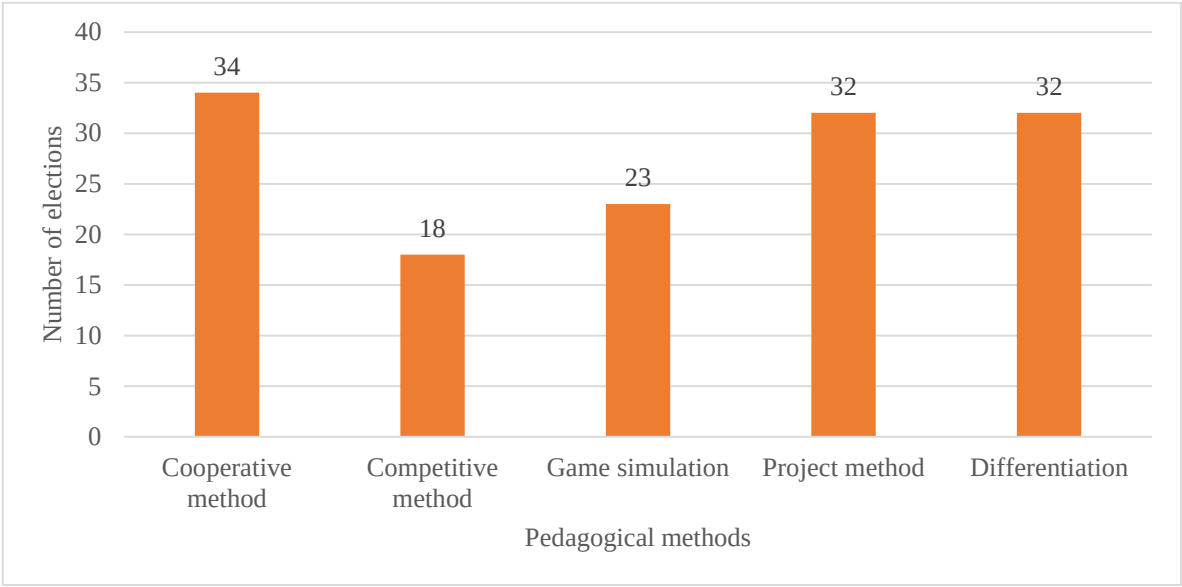


Figure 12

Application of new generation pedagogical methods in agricultural education

(Several answers could be ticked)

Source: Own data collection and editing, 2020

The graph shows that the differentiation, project and cooperative methods are used in equal numbers (32-34), while the competitive (competition) and game methods are significantly marginalised in the pedagogical work. The competitive method was chosen by 18 and the game and simulation method by 23. One of the reasons for this, based on the experience in the literature, may be that simulation, role-playing and games are teaching methods in which pupils acquire concepts through experiential learning, but in which a greater degree of preparation is required to implement the method, and that children may also want to play but not learn. This

can disrupt the classroom and the work. Competitive methods are likely to have the same effect, where the competitive spirit may result in a lack of discipline in the classroom.

An interesting question for me is whether the methods used in pedagogy are related to the number of years spent teaching. In order to analyse the relationship between these two factors, I have made a summary table with the categories I have defined and the number of respondents. The data are presented in Table 6.

Table 6

Description of the categories by years of teaching

Categories	Number of years in teaching	Number of respondents
1	1-3	3
2	4-7	16
3	8-10	5
4	11-15	12
5	16-20	13
6	21-30	13
7	31-40	5
8	40 or above	1

Source: Own data collection and editing, 2021

Figure 13, which shows the use of traditional methods in relation to years in teaching, shows that explanation and lecture are the leading traditional methods, while group and pair work, which are considered as new generation methods, are used more by younger generation teachers in their lessons.

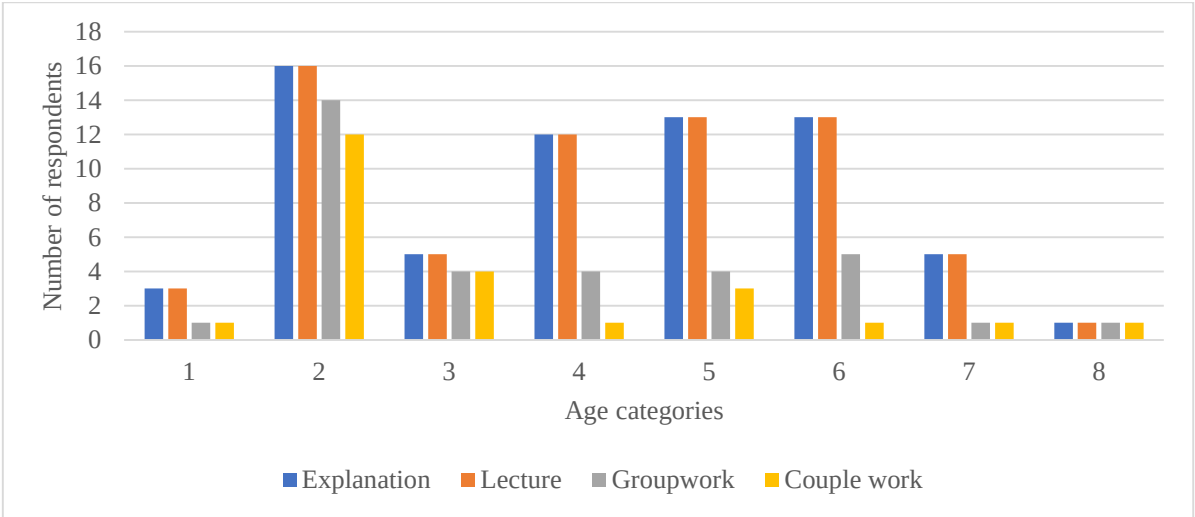


Figure 13

Use of traditional methods in relation to years of education

Source: Own data collection and editing, 2021

Among innovative pedagogical methods, differentiated teaching and cooperative methods are less popular with the older generation of teachers. The project method was the method most frequently mentioned by respondents (on average six), while games and simulation were the least used in pedagogical practice by 28 respondents. The results are presented in Figure 14.

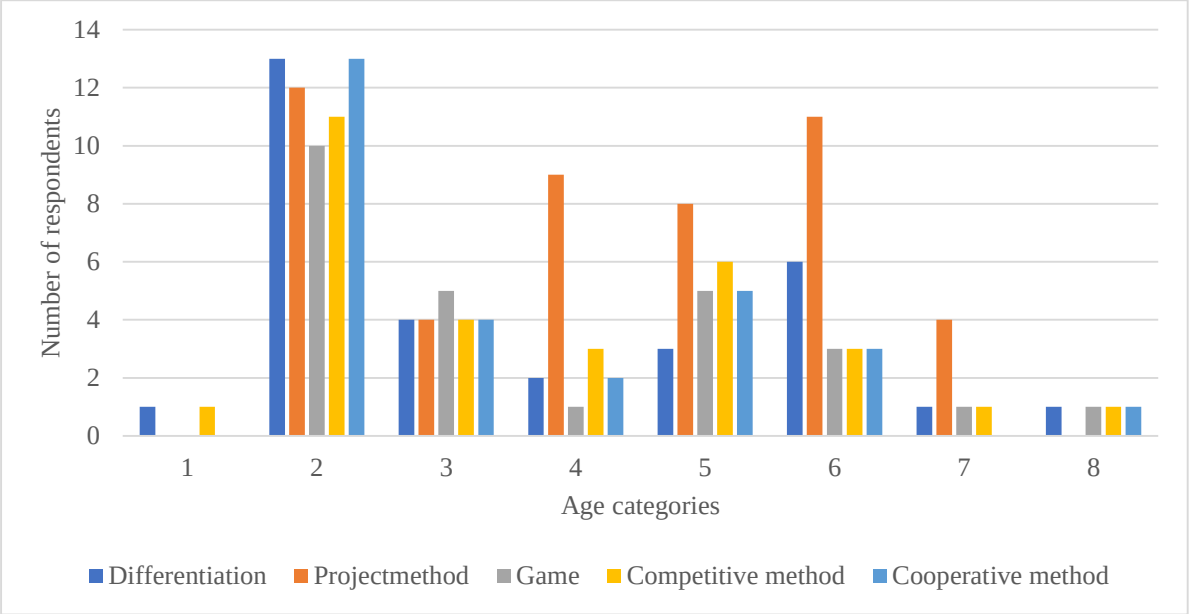


Figure 14

Use of innovative methods in relation to years in education

Source: Own data collection and editing, 2021

A similar trend can be observed for the answers to the question on the use of the tools used. The longer the time the respondent teacher has been in education, the more reliant he or she is on traditional teaching aids such as printed textbooks. It should be added, however, that the factors influencing the use of textbooks include the rapid development and innovation of relevant content for professional knowledge and the technical tools used in animal husbandry, which print literature cannot keep pace with. Younger teachers are generally more open to researching modern content on the web, whereas older teachers may find this option strange and stick to more traditional methods and tools. The use of textbooks in relation to years of teaching is illustrated in Figure 15. It can be seen that the younger generation uses textbooks to a lesser extent (7-20%), while the older generation relies more heavily on textbooks for teaching (50-100%).

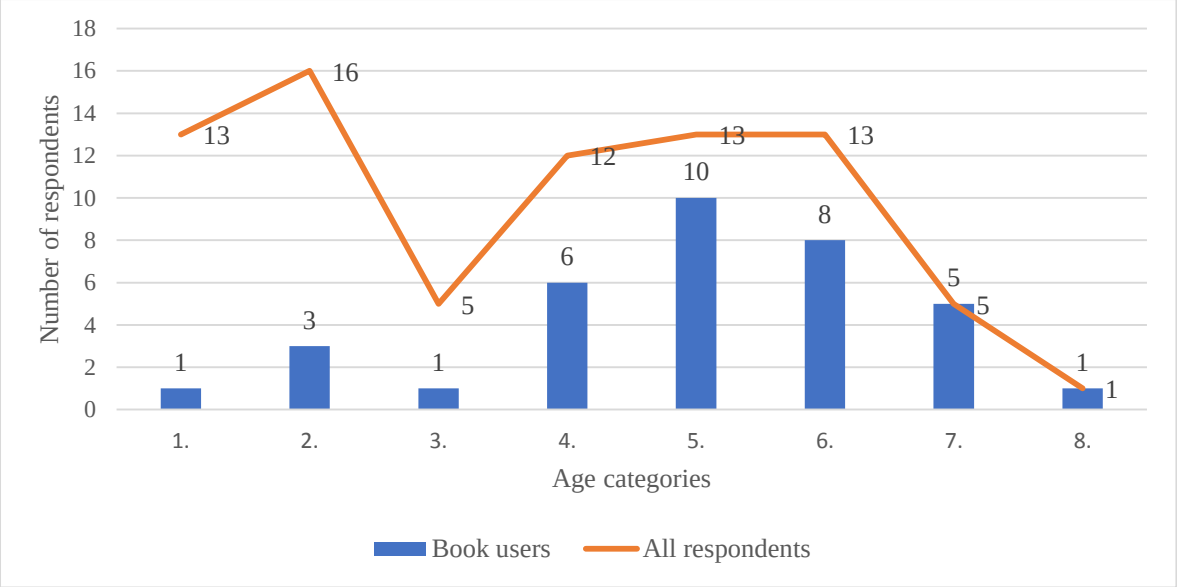


Figure 15

Textbook use as a function of years of teaching

Source: Own data collection and editing, 2021

The projector and the computer are the leading teaching tools, which can be attributed to the common, everyday use of frontal classroom work. Most students use the PowerPoint presentations developed in the classroom to process new knowledge, for which a laptop and a projector are essential technical requirements. Among the new generation of pedagogical tools used, the use of smartboards (29%) and visualisation models (39%) is less widespread, and its use in the pedagogical teaching work also depends to a large extent on the technical equipment of the school. I would like to stress that the use of interactive whiteboards is not known to everyone, as they are operated with special software that is not available to all institutions and teachers. The distribution of the use of educational tools is shown in Figure 16 and the age distribution of the tools is shown in Figure 17.

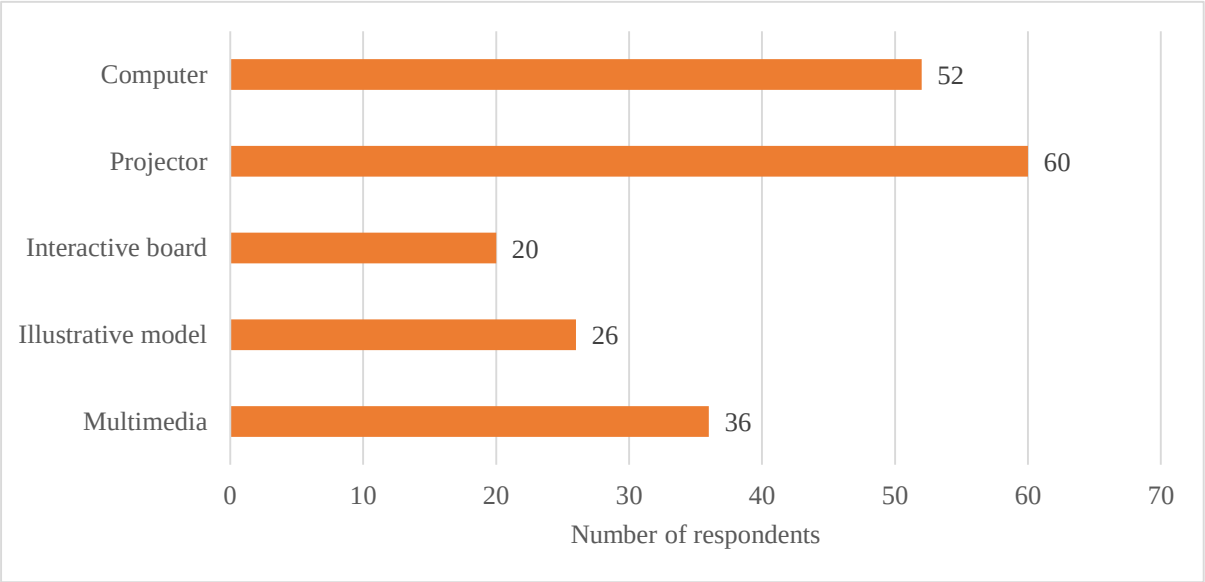


Figure 16

The use of new generation pedagogical tools in agricultural education

Source: Own data collection and editing, 2020

Looking at the extent of use of new generation devices in relation to years of teaching, all age groups rely primarily on computers and projectors to deliver lessons. It is also important to point out that multimedia tools and visualisation models are used more by older age groups. Many educators use traditional models, which are methodologically well-designed tools that were usable and up-to-date in their time, but their condition and the lack of modernity of models that show technical tools, such as models of animals or visual aids, are increasingly outdated.

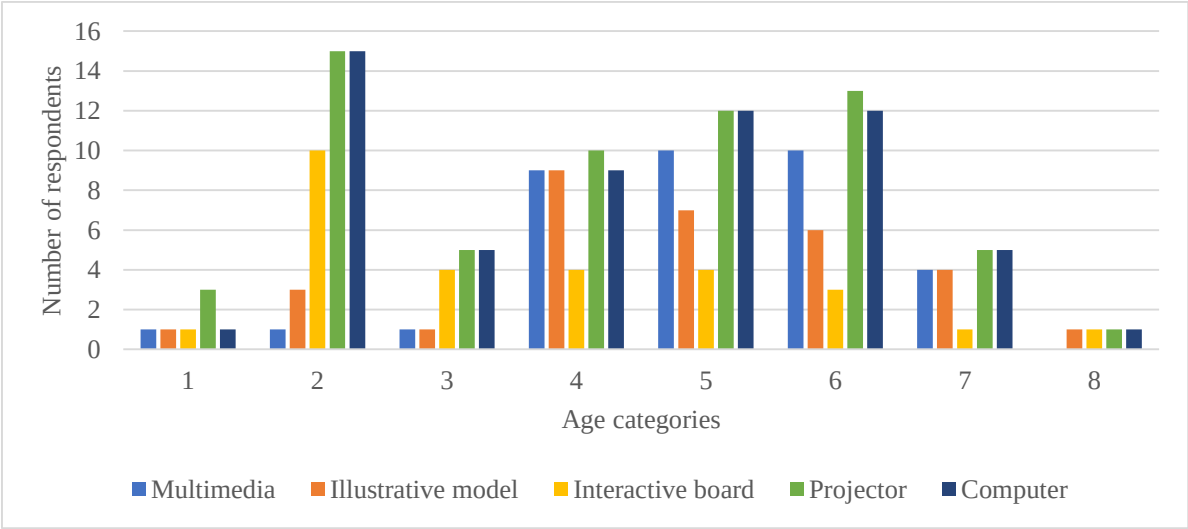


Figure 17

Use of new generation pedagogical tools as a function of time spent teaching

Source: Own data collection and editing, 2020

The breakdown of the use of new generation devices by school is shown in Figure 18, which also gives an indication of the technological readiness of the institution. It can be seen that all the institutions have basic technological tools, with the exception of the second school, where the internet and the interactive whiteboard were not included in the list of tools, but are probably just missing from the repertoire of the respondent teacher's toolkit. It can also be seen that the use of interactive whiteboards and visual models is taking a back seat, with most teachers relying on computers and projectors.

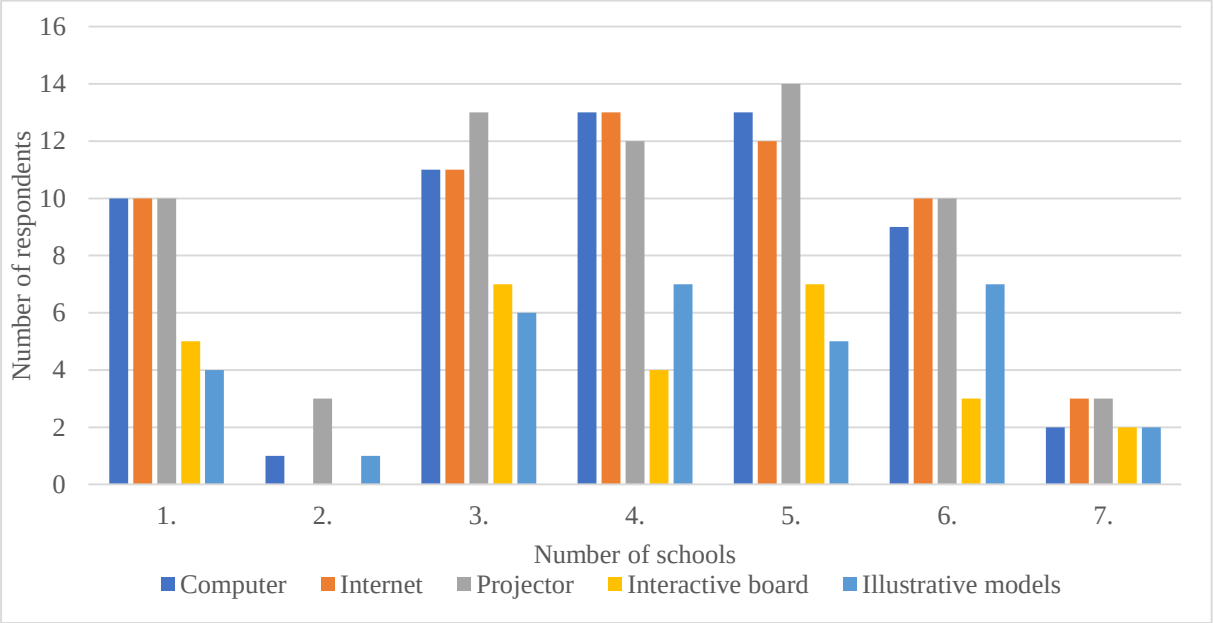


Figure 18

Use of new generation pedagogical tools by school

Source: Own data collection and editing, 2020

When asked about the extent to which my colleagues use and are familiar with the ICT tools that can be used in the pedagogical process, none of the respondents ticked the "I don't use" category. Seven respondents marked the category "Know but do not use", nine "Know" these tools but "Unsure about their use". In the teaching process, 52 of the teachers who responded often use these tools in their work. The question was also examined in terms of gender, the results of which are presented in Table 7.

Of the response categories, "Frequently used" ICT tools during the lesson was more frequently selected by males. The answer "Knows but does not use" was marked by seven of the women, none of the men. Two of the women selected "Knows but unsure about using", seven of the

men selected it. Overall, both sexes are equally familiar with ICT tools, but men are in the lead in terms of their use.

Table 7

Frequency of ICT device use by gender

Categories/ number of respondents	Female	Male	Total
"Do not use"	0	0	0
“Knows but does not use”	7	0	7
„Knows but not sure about using”	2	7	9
„Frequently use”	17	35	52

Source: Own data collection and editing, 2020

As a result of the questions on the use of ICT tools, 54 of the respondents mentioned PowerPoint presentations and 58 regularly use the internet in class. Noteworthy is the emergence of the smartphone as an ICT tool in the classroom. In this light, it would be worth considering the development of applications that can be run on smartphones, allowing certain professional simulations to be carried out by the student at home or in the classroom, alongside teacher instructions. Internet use includes watching educational films on video-sharing portals or searching for images related to the subject matter. The age distribution of ICT tools is illustrated in Figure 19, where it can be observed that the older generation uses only the Internet and PowerPoint, while the younger generation also uses Blogs and Twitter, building on the age specificities of the learner.

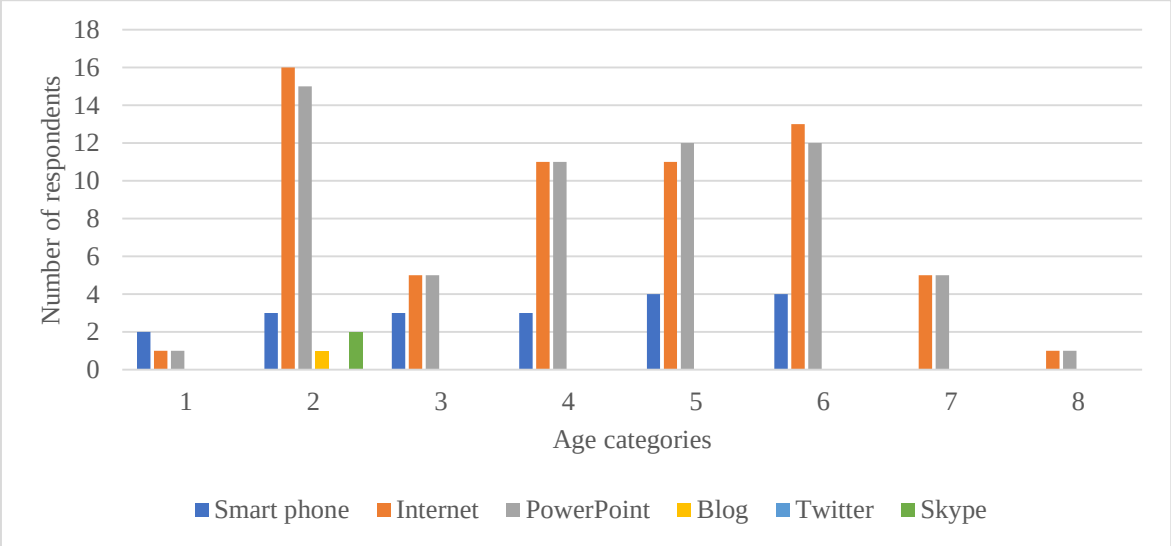


Figure 19

Use of ICT tools by age

Source: Own data collection and editing, 2020

In the next group, my colleagues rated the truthfulness of the questions I asked on a scale of 1-5.

The choices assigned to the numbers were as follows:

1./ I do not agree at all with the statement.

2./ I tend to disagree with the statement.

3./ I do not know the answer.

4./ I agree with the statement.

5./ I agree completely.

The statistical analysis of the statements is summarised in Table 8.

Table 8

Summary of the responses to this set of questions

QUESTIONNAIRE	AVERAGE	MODE	MEDIAN
1./ Teacher preparation	3,05	3	3
2./ Learning ICT tools takes too much time	2,75	3	3
3./Inadequate supply of institutional tools	2,58	2	2
4./ Work done with ICT tools and results	2,48	2	2
5./Learners' interest in ICT lessons	2,02	2	2
6./Tendency of students to use the Internet	2,91	2	3
7./Learners' difficulties towards ICT tools	3,19	2	3
8./Students benefit from using ICT tools	4,00	4	4
9./Computer literacy is a requirement of modern times	4,69	5	5
10./ The use of ICT tools is developmental for students	4,47	5	5

Source: Own data collection and editing, 2021

My first statement is: "Teacher training has not prepared me to use ICT tools sufficiently."

As can be seen from the data in Figure 20, 21 of the respondents ticked the category "I don't know", 24 ticked the category "agree" and 23 ticked the category "disagree", giving a half to half ratio of opinions on the preparation of teachers for ICT tools. The background to these answers can be found mainly in information forgotten during university years and no longer used in everyday practice, and in differences between teacher training courses.

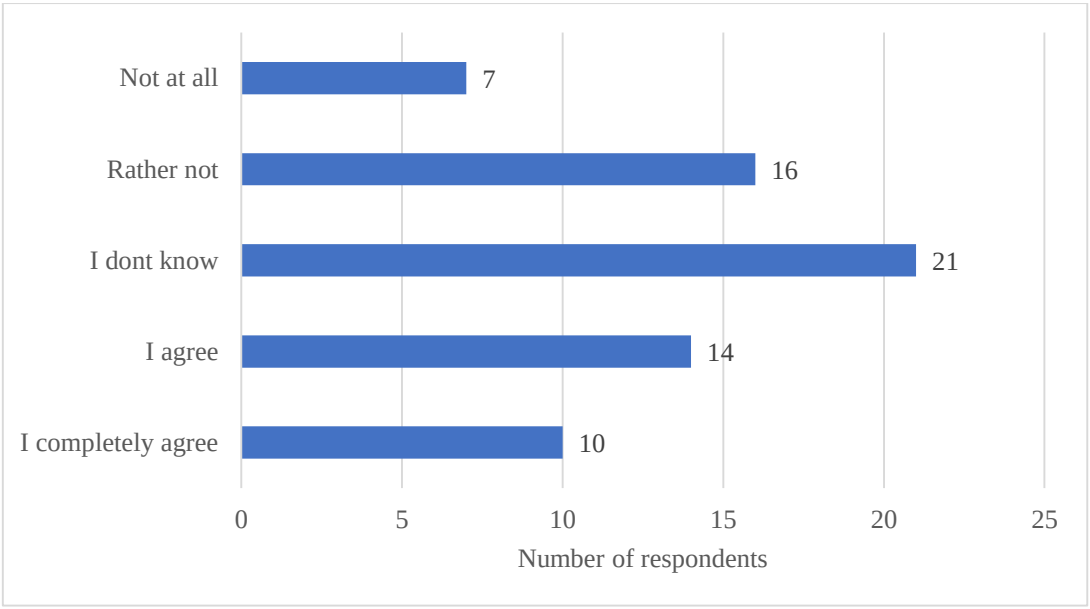


Figure 20

Preparing teachers to use ICT tools in teacher training

Source: Own data collection and editing, 2020

Analysing the responses received in the context of schools, the highest proportion of schools agreeing with my statement that there is inadequate teacher training in the use of ICT tools is one school, while the majority of schools agree with the first answer. The results are illustrated in Figure 21.

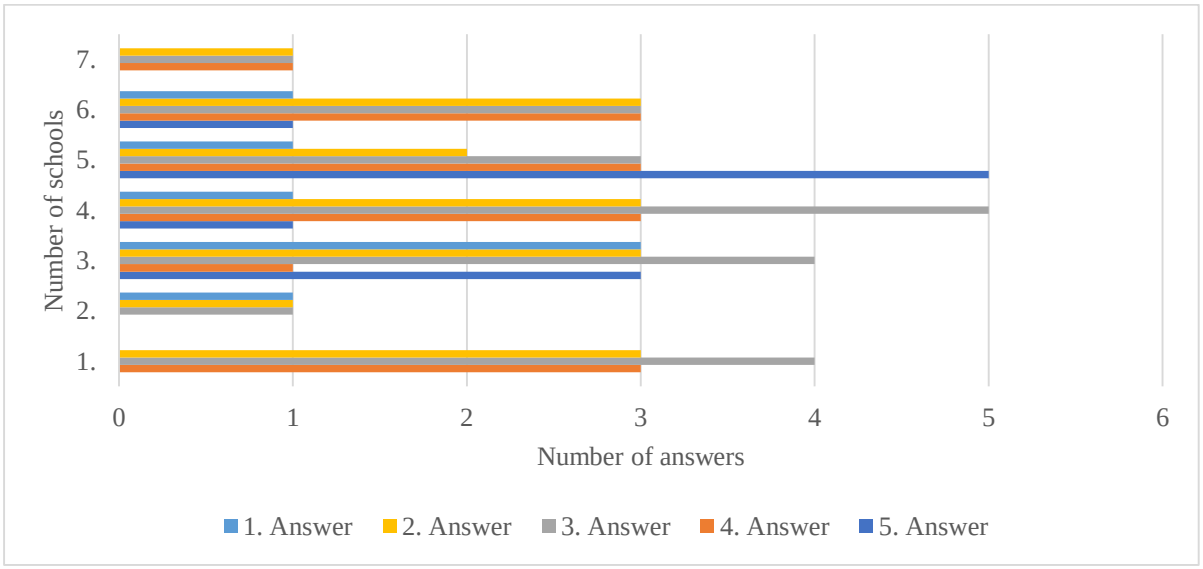


Figure 21

Preparing for the use of ICT tools in the inter-school split

Source: Own data collection and editing, 2020

My second claim: "Learning to use ICT tools takes too much time."

The data in Figure 22 shows that the category "I don't know" was again marked by a very large number of teachers, 25 in total, a result I attribute to the fact that for many of us the use of ICT tools is obvious in our daily lives, so it does not take extra time and effort to transfer knowledge into the classroom. 17 teachers agree with my statement, while 26 teachers tend to disagree or not agree at all with my position. In my opinion, the evolution of the responses is clearly to be found in the frequency of use of pedagogical tools. Those who regularly use ICT tools in the classroom are aware that their use requires a certain amount of routine and preparation, which requires an extra time commitment on the part of the teacher.

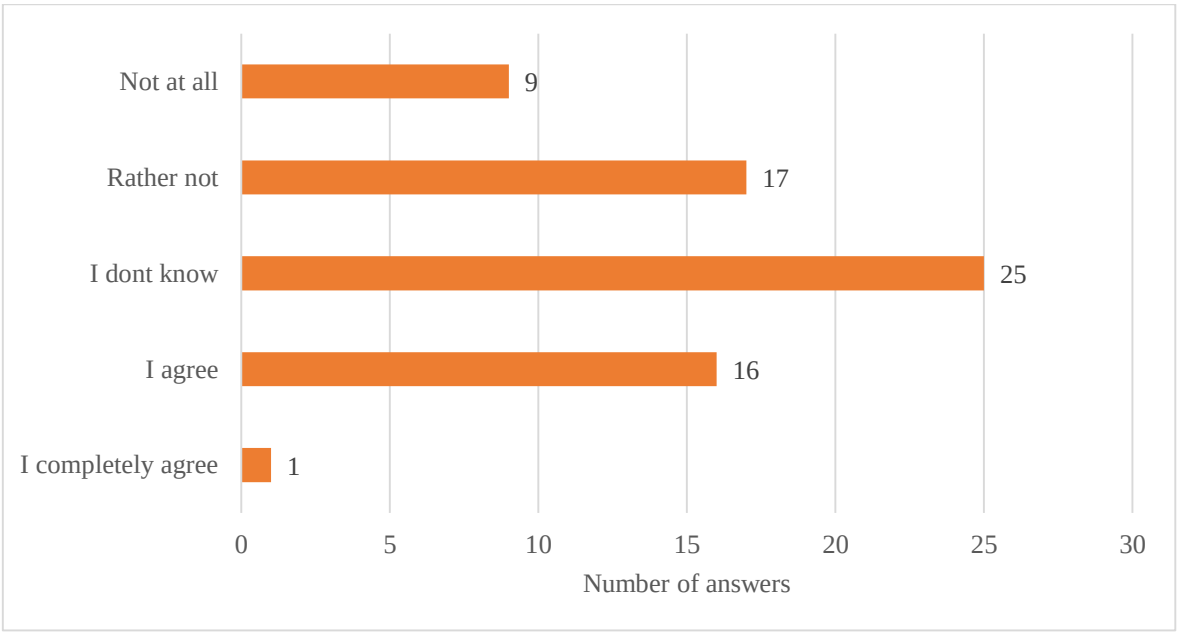


Figure 22

Time needed to learn ICT tools

Source: Own data collection and editing, 2020

In my third statement I stated that "Our institution lacks the tools to apply innovative methods." This seems to be a question that only makes sense to consider on an institution-by-institution basis, but it is not the only issue at stake. It is also a question of how satisfied teachers in general are with the tools they have at their disposal. The responses to this statement are illustrated in Figure 23. Three respondents fully agreed with my statement that there is a definite lack of these types of teaching tools. Ten out of 68 respondents believe that the conditions are not met for innovative pedagogical methods based on ICT tools to be implemented in the teaching process. 37 of the colleagues think that their school is sufficiently equipped with ICT-based teaching tools. The second answer to this question (mode: 2) is the one most of my colleagues

prefer to disagree with my statement, which means that they have the necessary tools to apply innovative methods.

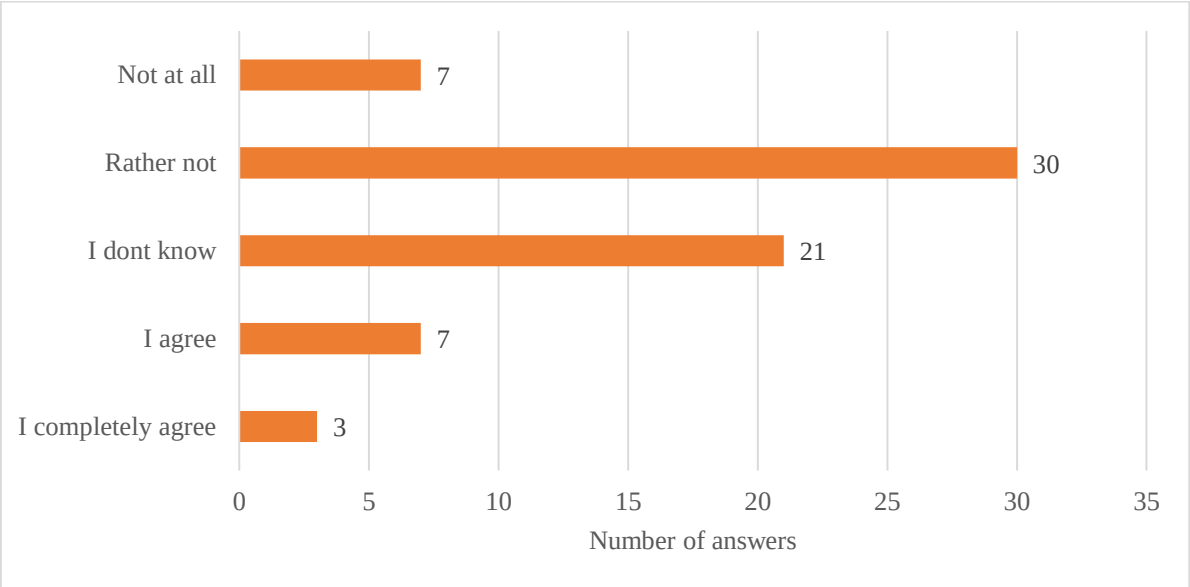


Figure 23

Availability of necessary equipment in the institutions

Source: Own data collection and editing, 2020

Figure 24 shows a breakdown of the responses by school, which also confirms the result that teachers in the schools mostly agreed with the second statement, with staff in the first and fourth schools being satisfied with the facilities in their institution.

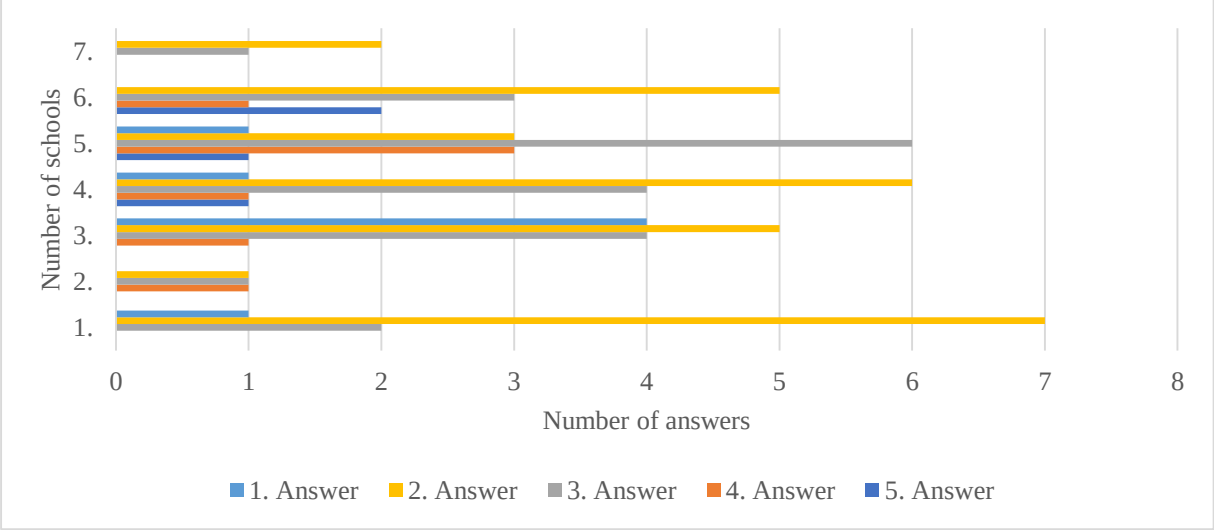


Figure 24

Assessment of the availability of necessary equipment, broken down by school

Source: Own data collection and editing, 2020

Statement 4: "The effort put into using ICT tools is not matched by the results." 27 of my respondents agree with my statement, i.e., the extra work spent on the use of ICT tools to prepare for ICT-based education is not rewarded. 38 disagree with my statement and consider that the time and effort spent on the use of ICT tools is recouped in the pedagogical work. In the light of the statistical results (mode:2; median:2), it can be stated that the extra time spent preparing for teaching with ICT tools (if and when necessary) is definitely a positive investment and has a positive impact on pedagogical work. In my opinion, it is primarily in motivating students and raising their awareness of the subject matter that results can be achieved by using such methods.

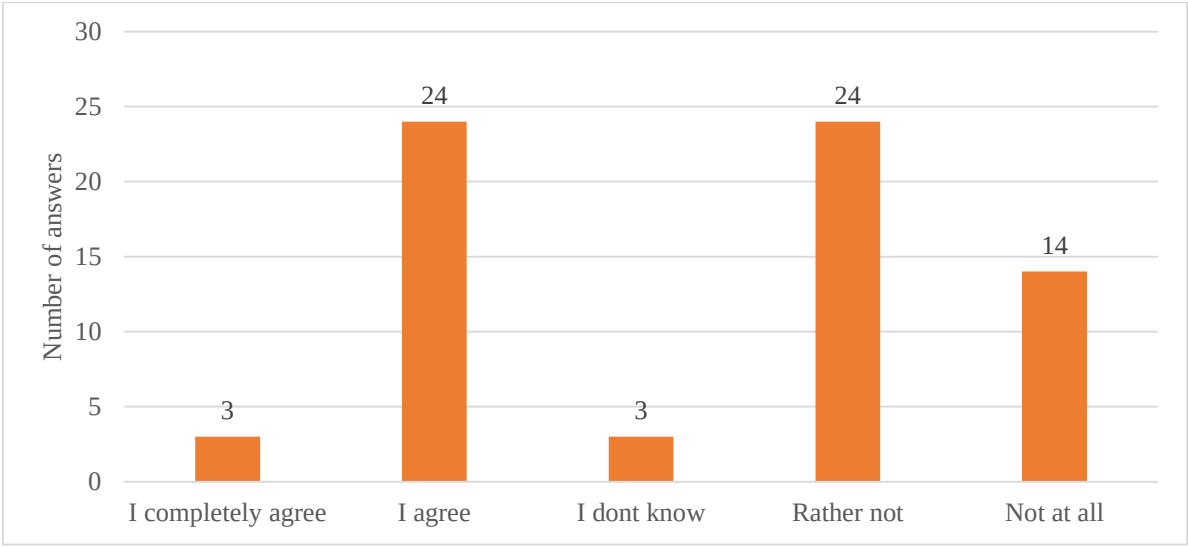


Figure 25

"The effort put into using ICT tools is not matched by the results."

Source: Own data collection and editing, 2020

In my opinion, the negative responses are mainly dominated by the younger generation, who naturally do not find the introduction of innovative educational technology tools to be a source of extra work in preparing or delivering lessons. The results are illustrated in Figure 25 and the age-related responses in Figure 26.

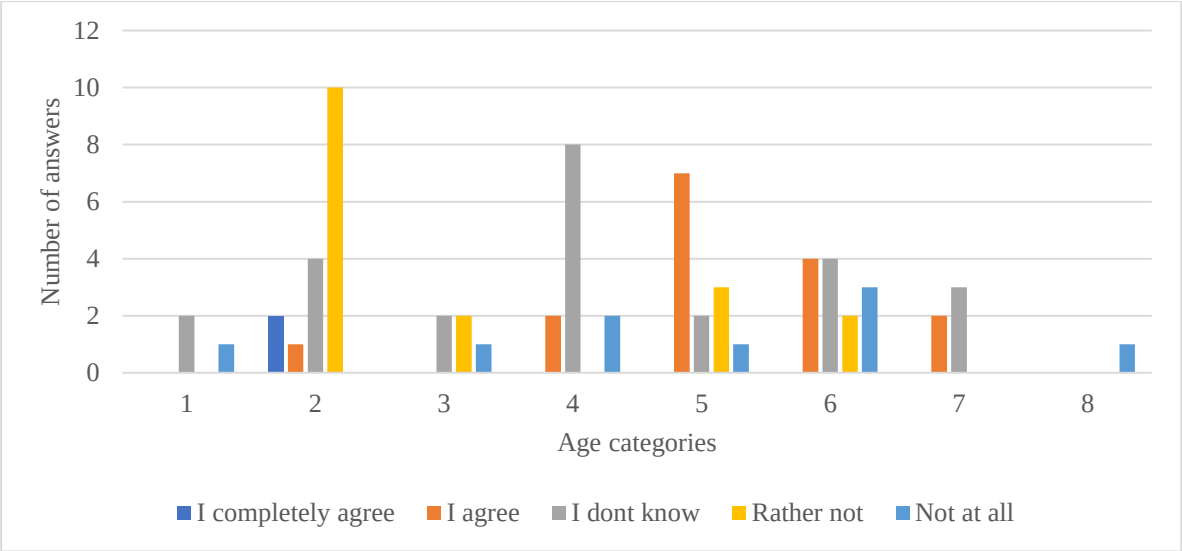


Figure 26

Assessing the effectiveness of ICT tool use by age category

Source: Own data collection and editing, 2020

Statement 5: "Students' interest is not affected by the use of ICT tools in the classroom." 7 of the respondents have a similar opinion that the tools used for teaching do not influence the interest of pupils, and a very high number of 49 think that teaching based on ICT tools has a higher success rate among pupils. Also in the statistical analyses, "I tend to disagree with the statement" is scored as mean: 2; mode:2 - i.e., the most frequent answers reject the correctness of my statement. Figure 27 presents the results of the research.

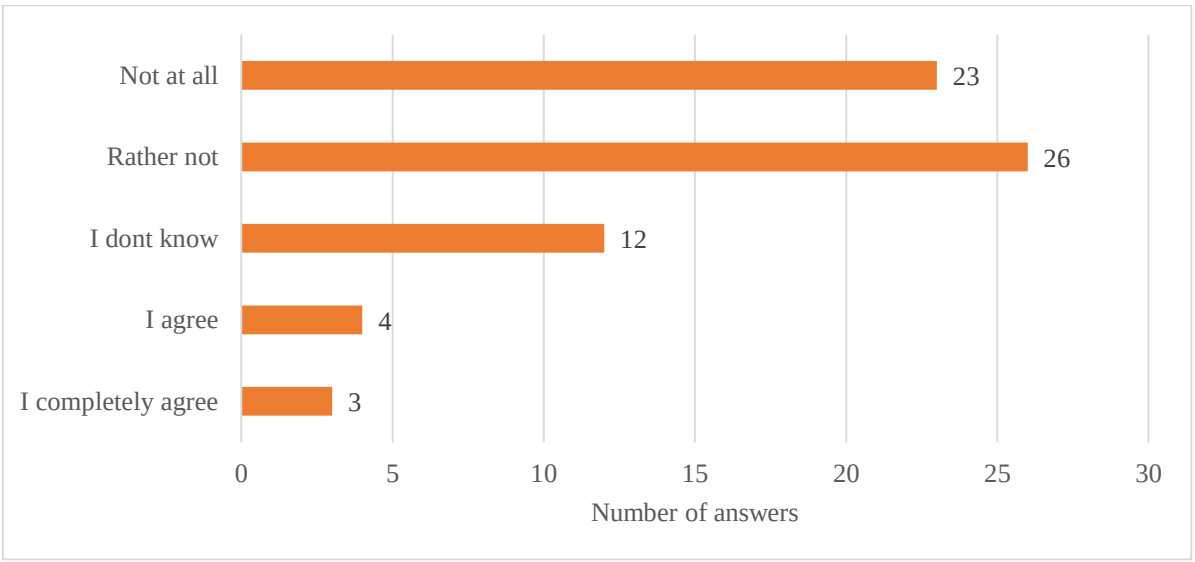


Figure 27

Learners' interest in ICT tools

Source: Own data collection and editing, 2020

Statement 6. 25 of the respondents agree with my statement that students use the opportunities offered by IT tools mainly for their own purposes and do not take advantage of all these opportunities in the learning process. Overall, however, 30 respondents (19 rather not and 11 not at all) answered in the negative to my statement. It is likely that the evolution of opinions has been strongly influenced by the recent need for online education, which has made the use of IT tools for learning a matter of course. The relationship between the statements is illustrated in Figure 28.

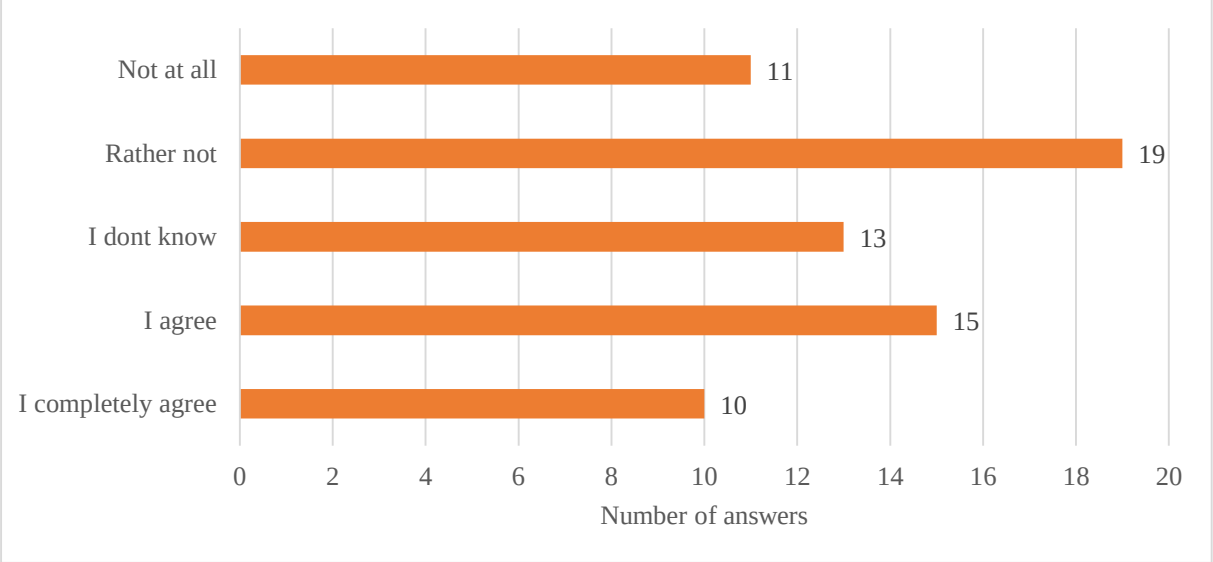


Figure 28

The purpose of internet use among students

Source: Own data collection and editing, 2020

Seventh statement: A larger proportion of teachers agree with my statement, with a total of 28 respondents answering in the affirmative that it is often the low level of pupils' IT literacy that is behind the failure to teach using innovative pedagogical methods based on ICT tools, while 20 teachers completely reject the validity of my statement. The category "I do not know" is also very highly marked in this option, also by 20 respondents. The opinions are summarised in Figure 29.

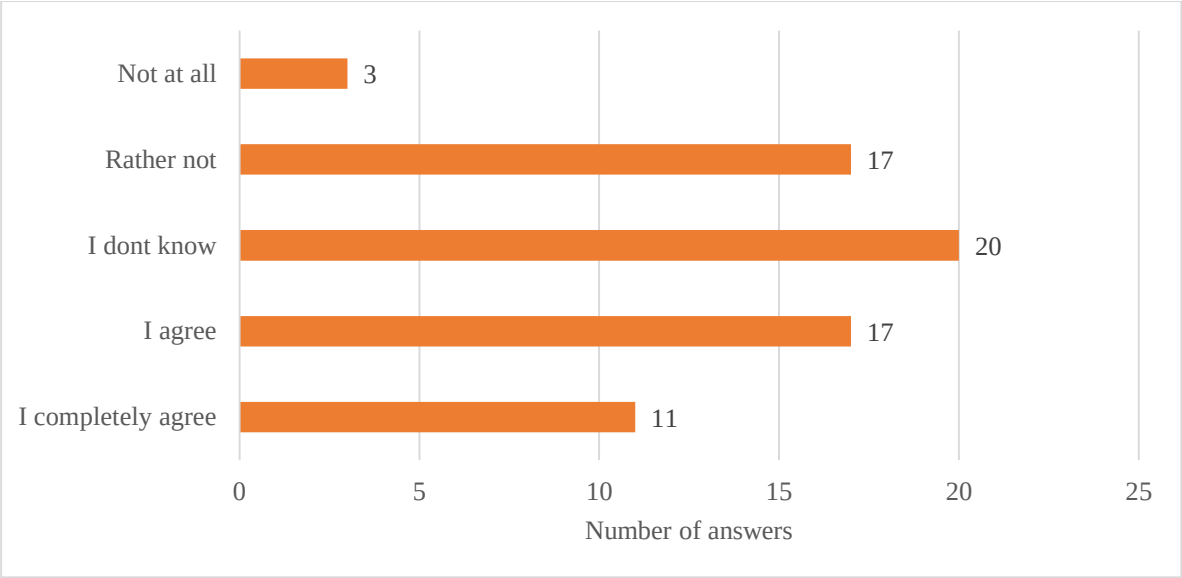


Figure 29

Assessing students' level of IT literacy

Source: Own data collection and editing, 2020

Statement 8: "Students benefit from the use of computers and ICT tools."

A very high number of respondents, 27 (mode: 4), agree with my statement that students' skills and abilities and learning processes are clearly positively affected by the use of ICT tools in the educational process. Today's secondary school students are constantly online, they live in virtual communities, they spend most of their free time online, they build their relationships on social networking sites and they cannot imagine a world without mobile internet and social media (Agriteach 4.0, 2019). It follows from the above that using methods and tools such as these can stimulate and sustain learners' interest. The responses are presented in Figure 30. My own experience and opinions are in line with those in the literature. Today's children cannot do without the virtual world. We, as teachers and educators, need to keep up with the evolving world and use all the tools and opportunities to direct learners' attention and interest towards learning.

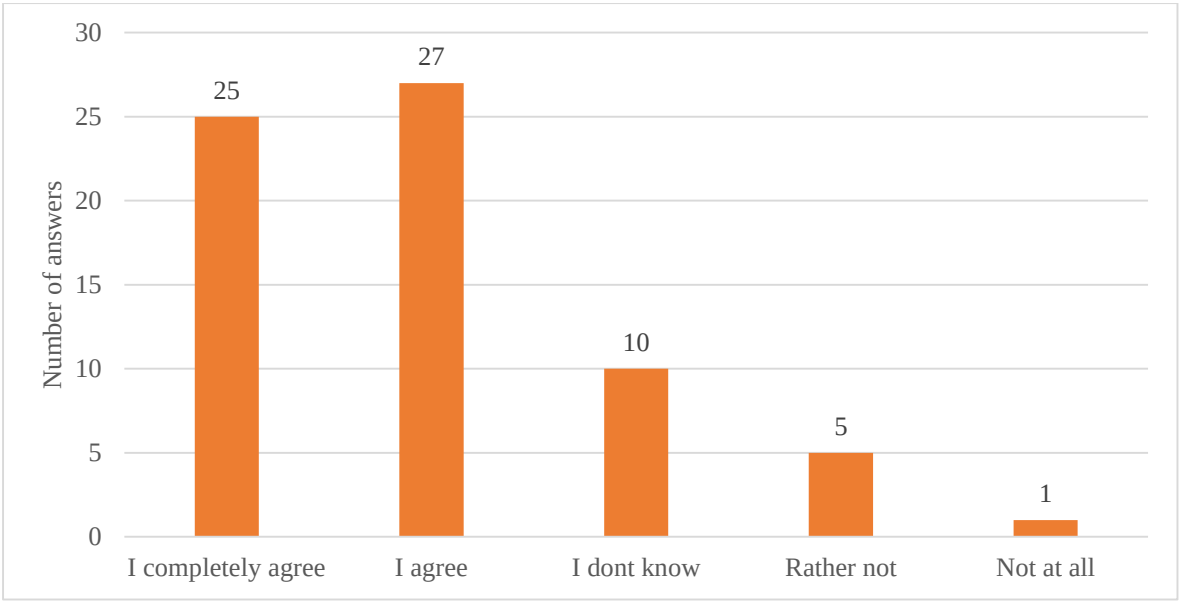


Figure 30

Benefiting learners through the use of ICT tools in the classroom

Source: own data collection and editing, 2020

Statement 9: "I agree with the view that the education of people who are able to meet the requirements of the modern age requires knowledge of the use of computers and ICT tools." The responses are illustrated in Figure 31, where it is clear that almost 100% of colleagues, 65, agree with this statement. An overwhelming 1 response marked "Not at all" and 2 marked "Don't know", which can be stated as a result of the choice. There is unanimity in the view that in the educational context of the 21st century, knowledge of the use of IT tools is an indispensable prerequisite.

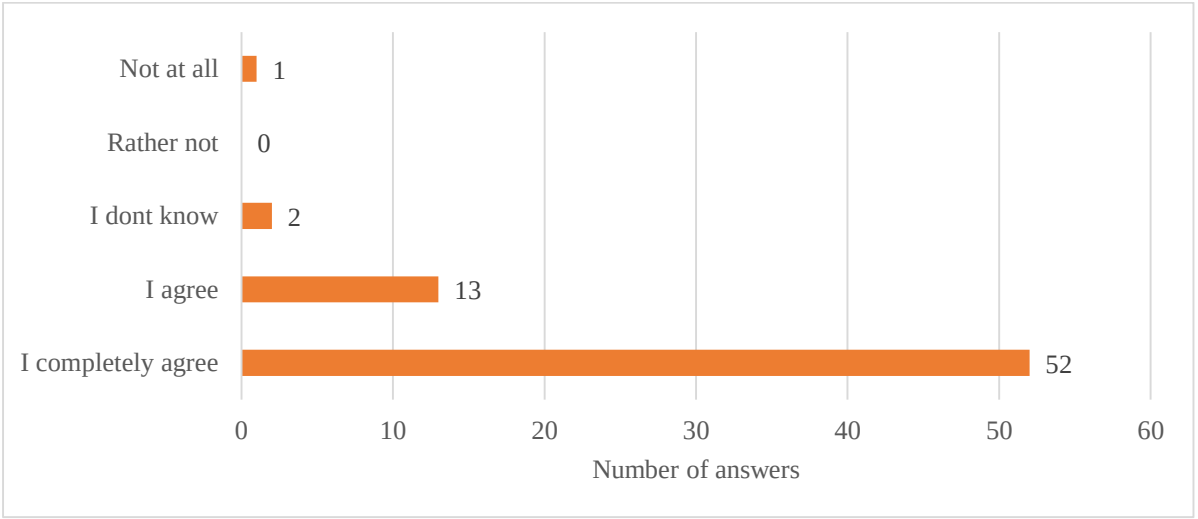


Figure 31

Knowledge of the use of computers and IT tools.

Source: Own data collection and editing, 2020

Finally, I based my last statement on the fact that a more active use of IT tools in education would increase the effectiveness of the teaching-learning process. The data for the responses are shown in Figure 32. Among the results, primarily, and also considering the statistical values, most of them agreed with this statement. Of the 68 responses, 62 agreed with the truth of my statement. Three respondents answered "I don't know" and only three respondents answered "I disagree" or "Not at all". Summarising the answers to the 10 questions, teachers clearly acknowledge the usefulness of IT and ICT-based pedagogical models, the importance and necessity of IT training, and the increasing role of IT in the teaching-learning process in pedagogical practice.

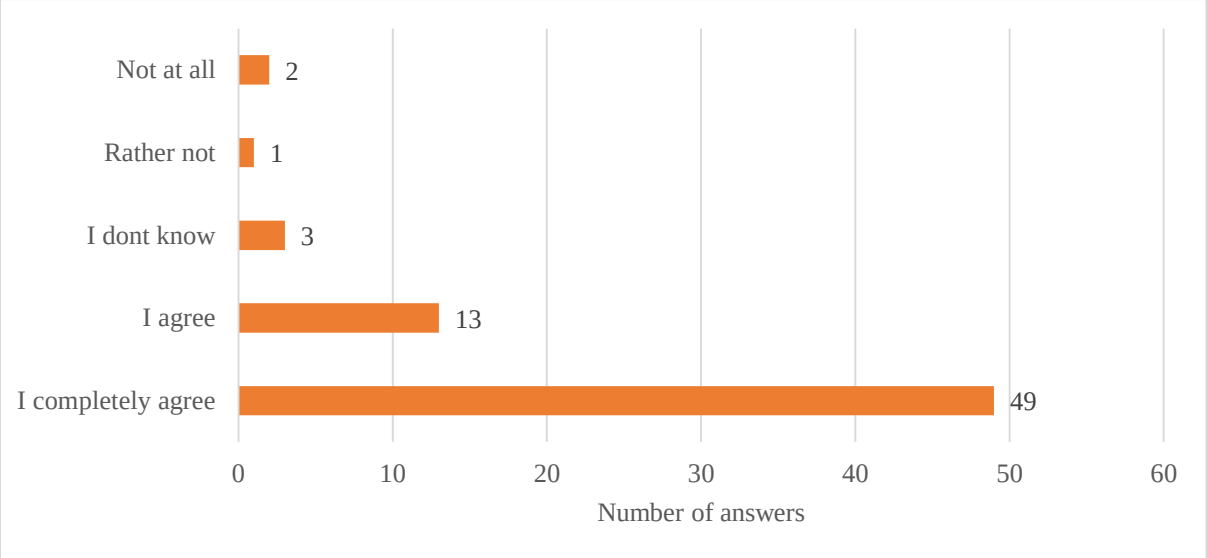


Figure 32

The positive impact of IT tools on the effectiveness of the learning process

Source: Own data collection and editing, 2020

My next questions were aimed at obtaining information on innovations in pedagogical methodology. There were several possible answers to this question. Of the respondents, 52 replied that they primarily obtain this type of information from their colleagues, which represents about 76.5%. 56 respondents mentioned further training (or training courses). 59 respondents mentioned internet as a source (86.76%), only 5 respondents referred to newspapers, magazines (7.35%), 18 respondents referred to conferences, events for information (26.47%) and 1 respondent described "self-discovery". Information from only one source was mentioned by 8 respondents (11.76%). The responses in terms of the proportion of time spent in teaching are summarised in Figure 33.

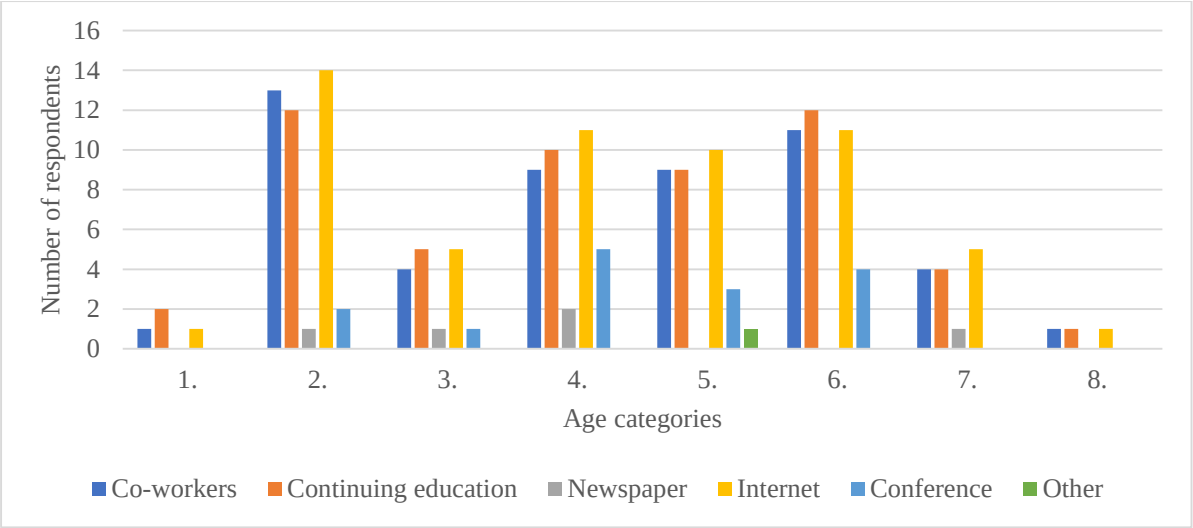


Figure 33

Sources of innovative information by age

Source: Own data collection and editing, 2020

It is observed that all age groups learn about professional innovations from the internet and from training courses, secondarily from professional conferences and from reading newspapers and magazines. The percentage distribution of information sources is summarised in Figure 34.

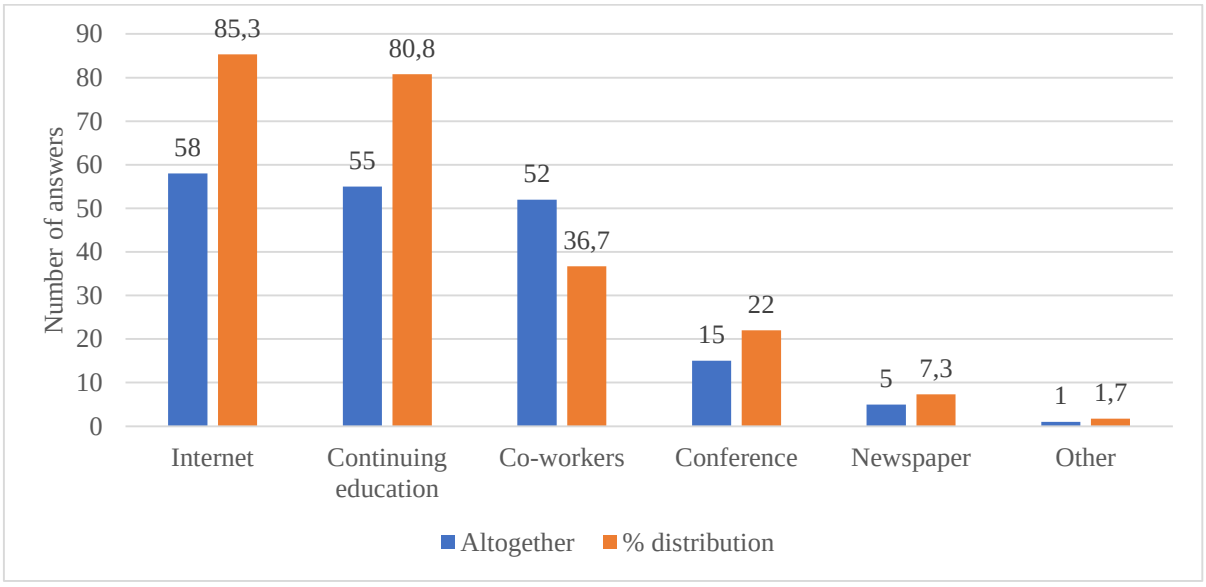


Figure 34

Percentage distribution of information source

Source: Own data collection and editing, 2020

For question 12, I measured the need for further training. Out of 67 respondents, 54 respondents would be willing to apply for training in specific teaching methods, 80.6% of the respondents. Training in conflict management strategies would be considered necessary by 56 respondents

(83.58%), and training in dealing with aggression and mental disorders by 54 respondents (80.6%). In addition, 9 respondents (13.43%) would like to receive training in psychology. 53 respondents (79.1%) would like to hear more about IT skills and 46 (68.66%) would like to hear about innovative pedagogy. Age-related responses are shown in Figure 35.

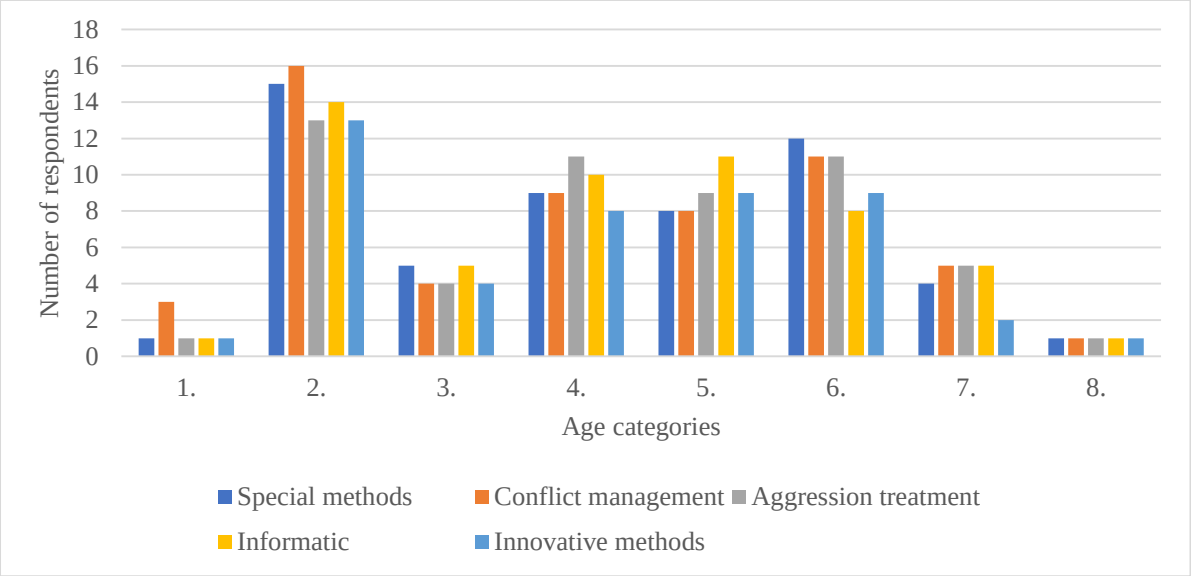


Figure 35

Demand for the content of training

Source: Own data collection and editing, 2020

It can be observed that the younger generation tends to prioritise participation in training courses on conflict management, focusing on ways of solving discipline problems in the classroom, and there is a very high demand for training courses on aggression management. The older age group would prefer training in IT and specialised methods.

A breakdown of the need for the content of training by school is shown in Figure 36. It can be seen that all schools do not attach any importance to training in psychology, but that conflict and aggression management is the leading subject in all schools.

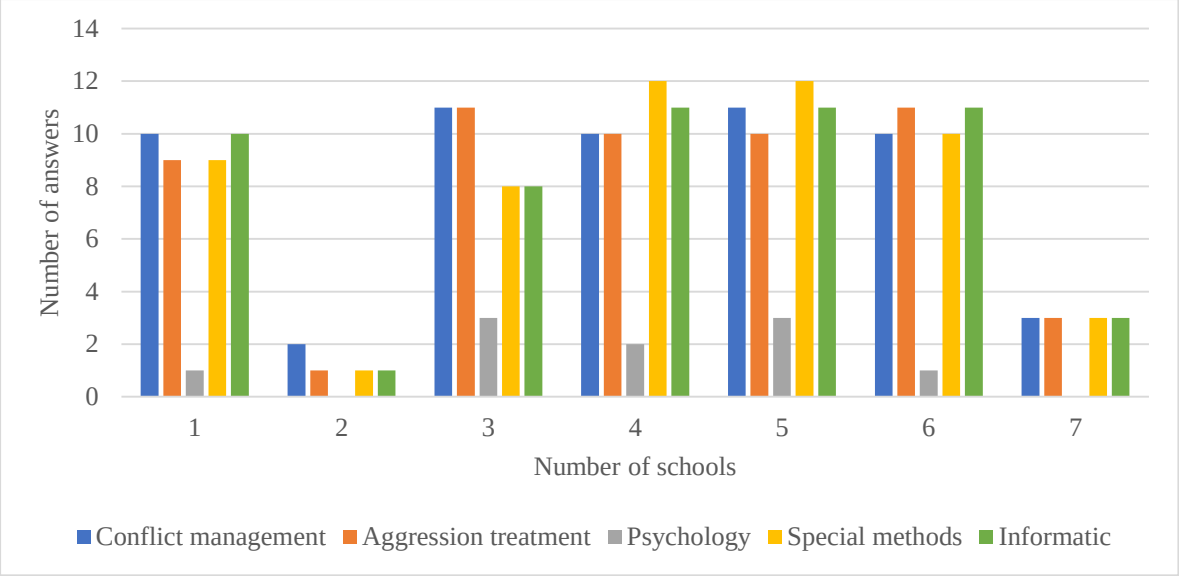


Figure 36

Demand for training content by school

Source: Own data collection and editing, 2020

Question 13 aims to explore the awareness of simulation programmes. The list of options mentioned by positive respondents was interesting, as none of them were simulations with a strictly educational purpose. Respondents mainly mentioned games such as farming simulator, which is not an educational but an entertaining program, and one respondent mentioned Autodesk Inventor, a 3D technical drawing program with applications to visualise movements. Some industrial simulation programs were also mentioned, but most of the answers given by the respondents indicate that simulation is generally understood as a tool for visualisation in the traditional sense. The knowledge of simulation methods is illustrated in Figure 37. The graph shows that the few respondents who have some knowledge of simulations are among the younger age group. The older generation is not familiar with these pedagogical methods.

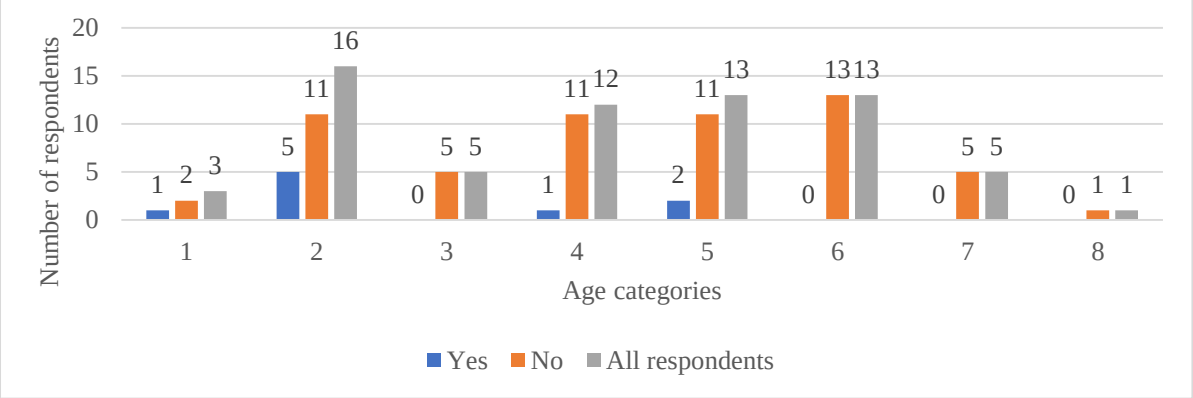


Figure 37

Knowledge of simulation models

Source: Own data collection and editing, 2020

Question 15 focuses on the impact of simulation methods on the teaching-learning process. As in the previous question, the question of relevance emerges. Many respondents mentioned the time-consuming nature of simulation, which again brings to the fore the problem raised in the discussion of the answers to question 8, but respondents also mentioned the effectiveness of the method due to its realism.

In the next step, I asked myself what are the reasons for the rejection of the use of simulation methods in pedagogical practice. Of the respondents to the other questions, 26% only shared their opinion on this issue. 10 respondents said that they were not at all familiar with such programmes or their use. Four mentioned the time demands already involved and four expressed the idea that neither the necessary tools nor the appropriate knowledge is available, both on the part of the teacher and the student.

Taking the idea further, I asked my colleagues to formulate what benefits they could associate with this pedagogical method if the use of simulation methods were unavoidable. In their text responses to the question, they mentioned maintenance of attention 25%, motivation 30%, efficiency 42% and practical application 27% as benefits they could expect to see in the future when using simulation.

The use of the model raises the question of whether the employer would finance the purchase of such a programme if the need arose. 32 respondents said yes (47%) and 36 said no (53%). Of course, the answer is theoretical, the proportion may vary if there is a real need, and this is where it makes sense to distinguish between institutions, as it is one of the most representative reflections of the prevailing work environment. An analysis of responses by school is shown in Figure 38.

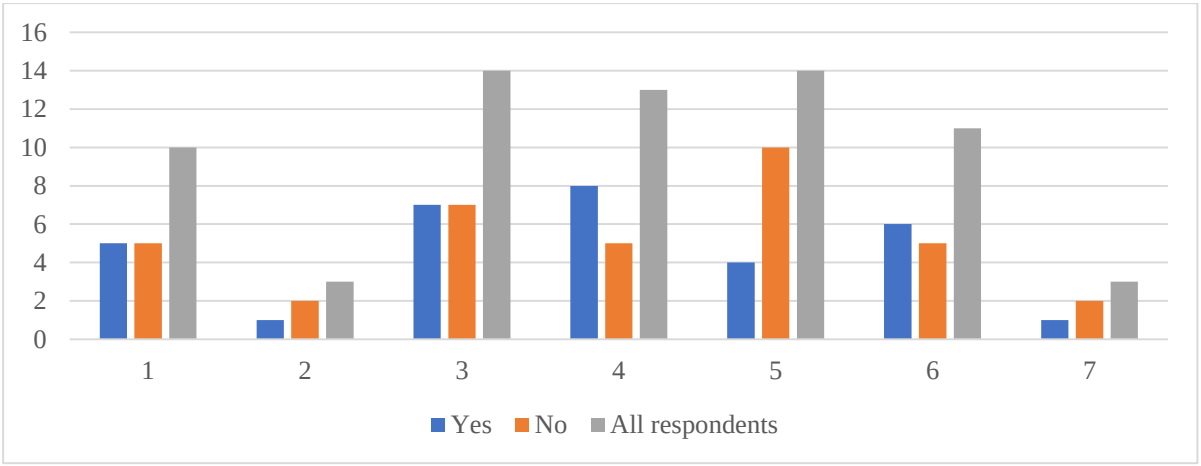


Figure 38

The willingness of schools to finance

Source: Own data collection and editing, 2020

Next, the question arises: to what extent do my colleagues consider the institutions to be prepared for innovation investments/activities? In addition to institutional innovativeness, this also raises the question of what respondents consider to be innovation activities and preparation for them? 69% of the respondents thought that no innovative investment or preparation for innovation had taken place in their institution, and the answers to the additional questions showed that the majority of those who answered in the affirmative (45%) understood hardware training as preparation for innovative activity, while some (15%) thought that training in motivation, methodology and conflict management had taken place. In practice, no training in simulation programmes or in the wider use of ICT tools has been provided, which teachers feel is a necessary gap to fill.

Finally, I asked questions about the implementation of institutional IT improvements over the last 3 years. The combined investments and funding by school are shown in Figure 39. Interestingly, teachers working in the same institution have different perceptions of the investments made by the institution and the willingness of schools to finance IT tools and programmes. With the exception of the institution marked with number five, the majority of staff consider that progress has been made in this respect, but the same institution has the highest number of staff who think that it would also take on school funding for IT development. Most of the improvements were for the purchase of laptops and projectors (30%) and less frequently interactive whiteboards (10%). It should be mentioned here that, in addition to the installation of interactive whiteboards, it would be necessary to support the purchase of the associated projector, writing instruments and drive software, without which the value of a whiteboard intended to be interactive would be reduced to the most expensive projection screen in the world.

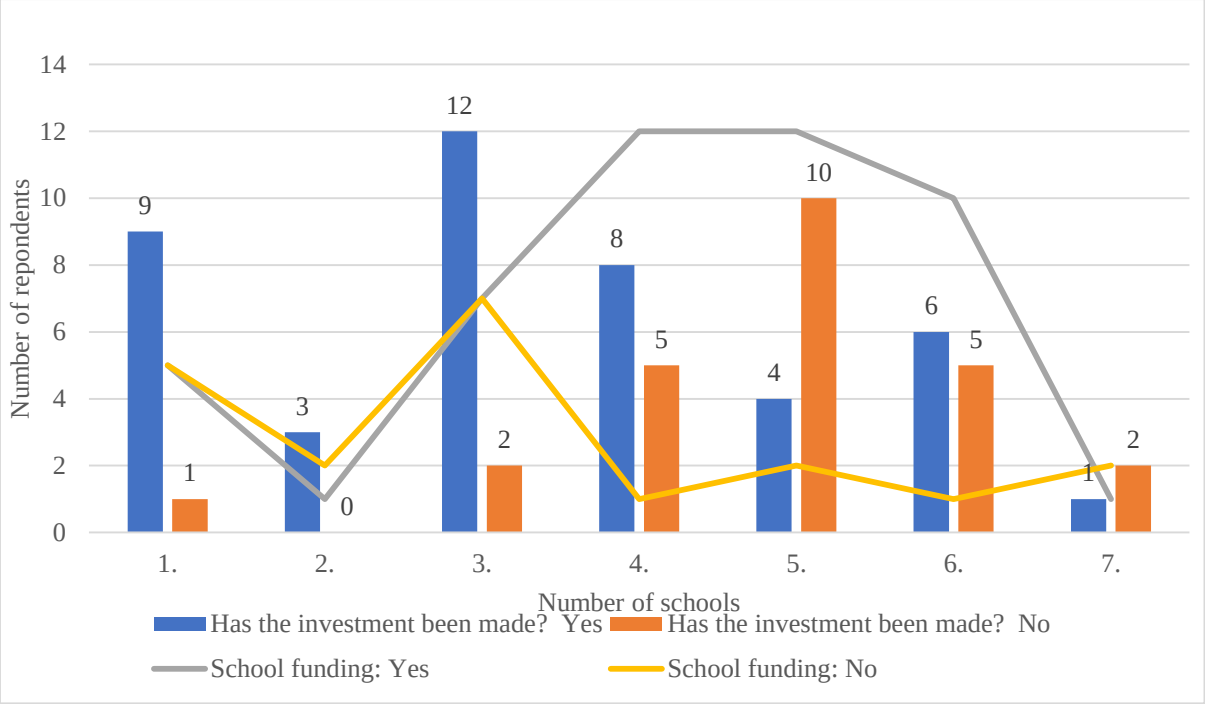


Figure 39

Assessment of the level of investment by school

Source: Own data collection and editing, 2020

3.5 RESULTS OF SIMULATION MODEL APPLICATION AT THE MÓRICZ ZSIGMOND SECONDARY SCHOOL OF AGRICULTURE

3.5.1. PRESENTATION OF THE STUDENTS

The simulation model based on the data from the livestock farm was presented at the Móricz Zsigmond Agricultural Technical School in Kaposvár in November 2020, and in order to process the data more accurately, it was presented in May 2022 in a 9th vocational school class, in classes taught by me, which were selected according to the courses of study at the school. A summary of the characteristics of the classes is presented in Tables 9 and 10.

Table 9.

Description of the students involved in the simulation model

Subjects/classes	Year 9 / Farming	Year 11 /Farming	Year 11 / Technical School	Year 13/ Agricultural Technical School
Number of participants in the study	28	24	29	21
Boy	22	24	15	18
Girl	6	0	14	3
Number of entrants	25	19	21	10
Based on academic performance, the overall class average	average	average	is above average/good	average/good

Source: Móricz Zsigmond Agricultural Secondary School (own ed.), 2021

The subjects were selected for the knowledge they require to understand and apply the simulation. Thus, the theoretical and practical subjects of computer science, animal husbandry, economics and finance were selected.

As the data in the table show, students in both the vocational school and the intermediate and technical classes finished the 2019/2020 school year with average (medium) results. Unfortunately, the vocational and technical students did not take any computer science, while the vocational high school students had the opportunity to study computer science for two hours a week.

The names of the subjects related to the theoretical education of animal husbandry are quite varied, but all of them require the acquisition and knowledge of basic professional concepts and language.

In the area of practical training, there are significant differences between the different classes. While students in vocational schools alternate between theoretical and practical classes on a weekly basis, and those in technical schools spend two weeks every six months in external work placements, students in vocational schools have the opportunity to learn the practical application of their skills in a classroom setting.

Table 10.

End-of-year results for students participating in the simulation model 2019/2020

SUBJECTS TAUGHT	CLASSES				
	9./E	11./C	11./A	13./T/A	13./T/B
Grade point average	*3,27*	3,39	3,64	3,62	3,05
Computer science	*N*	N	3,96	N	N
Animal husbandry II	*N*	2,60	N	N	N
Animal husbandry	*2,58*	N	N	4,23	4,00
Feeding	*N*	N	3,25	N	N
Animal husbandry practical	*3,42*	4,48	N	3,95	3,86
Basic Animal Production Practices I. II.	N	N	3,76	N	N
Finance	*N*	N	4,21	N	N
Basic business management	*N*	N	N	4,41	4,10
Management skills	*N*	3,36	N	3,91	3,48

Source: Móricz Zsigmond Agricultural Secondary School (own ed.), 2021
N= No

The model was presented through an online system, in view of the Covid -19 situation in which I first tried to collect and organise the students' previous knowledge through a PowerPoint presentation, using a traditional system. In the introductory phase, I presented the world economic situation of pig production, the difficulties encountered in Hungary and the quality of production levels, using economic indicators of the sector. The introduction and the review of the basic technical concepts took one lesson, i.e., 45 minutes, followed by the presentation of the simulation model, which had already been sent online.

3.5.2. EXAMINING THE EFFECTIVENESS OF THE SIMULATION MODEL OF EDUCATION

Following the presentation of the model, a questionnaire was used to assess the effectiveness of the lessons and the model among the students in each of the three classrooms. The answers to the questionnaire were also evaluated and analysed using the SPSS statistical method. Results where $p < 0.05$ were accepted as significant. First, I wanted to know whether the students had the necessary IT skills and how these skills related to the type of school. The results are shown in Figure 40.

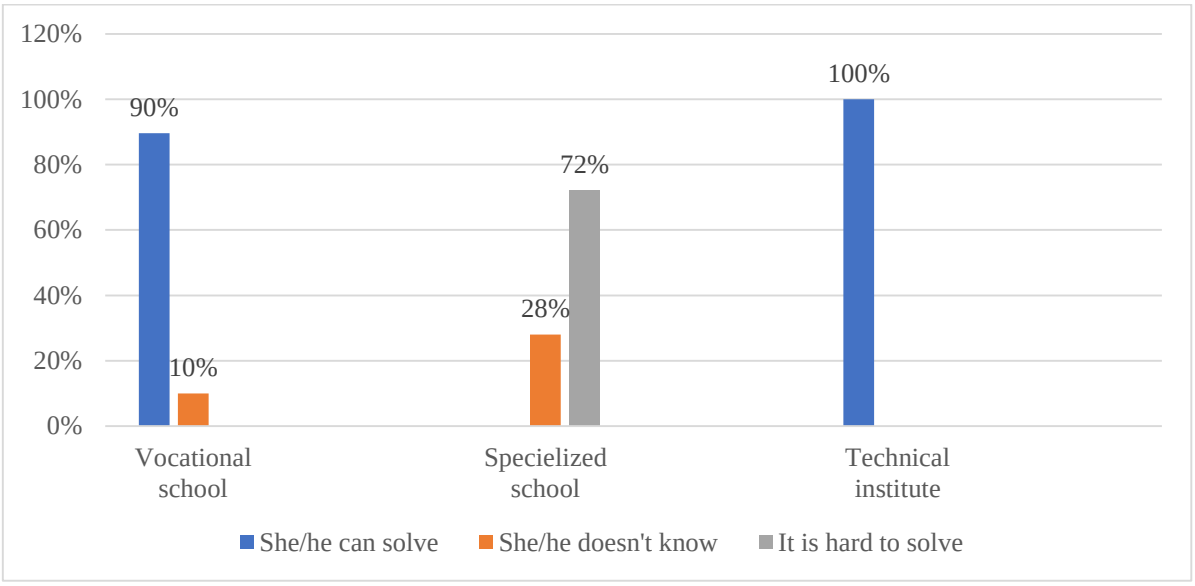


Figure 40

Difficulties in interpreting tables and graphs

Source: Own data collection and editing, 2021

The graph shows that students in technical classes are confident in their IT skills, while those in vocational classes are only marginally so. An examination of the relationship between the type of school and the existing knowledge of students is presented in Table 11.

Table 11.
Significance test results on the association between school type and IT skills

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2,264[a]	2	,322
Likelihood Ratio	3,872	2	,144
Linear-by-Linear Association	1,422	1	,233
N of Valid Cases	102		

Source: Own data collection and editing, 2022

Examining the data in the table shows that there is no correlation between the type of school and computer literacy, (p = 0.144-0.322) greater than 0.05, so there is no correlation in the data examined. I further investigated whether there is a relationship between computer literacy and the gender of the students The results are presented in Table 12.

Table 12.
Significance test results on the relationship between students' gender and IT skills

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,283	,004
	Cramer's V	,283	,004
N of Valid Cases		102	

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8,165[a]	1	,004		
Continuity Correction[b]	6,037	1	,014		
Likelihood Ratio	7,400	1	,007		
Fisher's Exact Test				,009	,009
Linear-by-Linear Association	8,085	1	,004		
N of Valid Cases	102				

Source: Own data collection and editing, 2022

Examining the results of the table, we can see that p is less than 0.05, (p=0.004) so there is a correlation between the gender of the students and their basic knowledge of IT. Cramer'sV =0.283 is low, which implies that there is a relationship between the variables under study, but the degree of this relationship is weak.

In order to acquire new knowledge, students need to be able to interpret the tables obtained in the simulation correctly, so I further investigated the extent to which students find it challenging to interpret the data in each table. The results are presented in Figure 41.

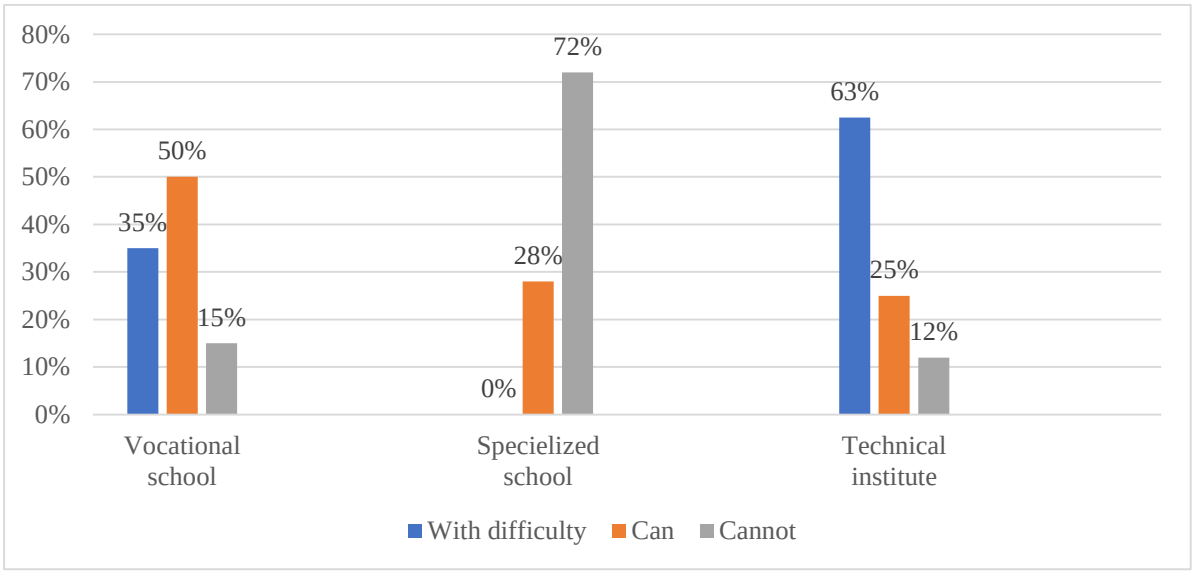


Figure 41

Interpretation of the data in the table

Source: Own data collection and editing, 2021

The results in the graph illustrate that our vocational students are at a significant disadvantage in this area. An interesting finding is that while students in technical education excel at creating tables, many have difficulty reading and interpreting the results. Looking at the frequency of the responses obtained, the data in Table 13 shows that, in terms of the mean (mean=3.12), (median=3), the 'prefer not to can't solve" category.

Table 13.
Frequency study results for data interpretation

Statistics

Interpretation

N	Valid	102
	Missing	71
Mean		3,12
Median		3,00
Mode		2[a]

Interpretation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	34	19,7	33,3	33,3
	3	28	16,2	27,5	60,8
	4	34	19,7	33,3	94,1
	5	6	3,5	5,9	100,0
	Total	102	59,0	100,0	
Missing	System	71	41,0		
Total		173	100,0		

Source: Own data collection and editing, 2022

Overall, there is an equal split between those who can interpret graphs and charts and those who have difficulty.

Table 14.
Correlation test results for data interpretation

ANOVA

érthetősége

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7,454	2	3,727	4,898	,009
Within Groups	75,340	99	,761		
Total	82,794	101			

Source: Own data collection and editing, 2022

With regard to the Anova test, presented in Table 14, it can be stated that there is a correlation between the difficulty of interpreting the data in the table and the type of school (df=2, p=0.009).

Further, I was curious to see if there was a correlation between boys and girls in terms of their ability to process Excel spreadsheet data. In Figure 42, the results for students in the vocational secondary school class are shown as a proportion of boys and girls. The graph shows that both sexes were able to solve the tasks related to the use of the Excel program in equal proportions. In percentage distribution, 53% of boys and 50% of girls have problems solving tasks related to this type of program.

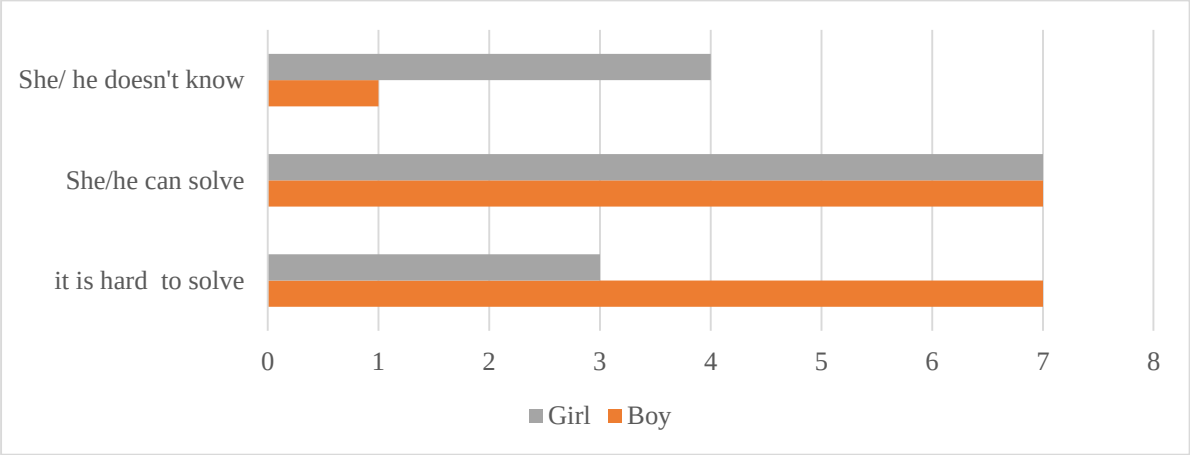


Figure 42

Interpretation of the data in the table in the ratio of boys to girls in upper secondary schools

Source: Own data collection and editing, 2021

In the light of the results, I investigated whether there is a difference between boys and girls in terms of processing IT data, not only for vocational high school students. The correlation was tested using the ANOVA model, the results of which are presented in Table 15.

Table 15.
Correlation analysis between the gender of learners and the interpretability of IT data

ANOVA

Interpretability

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6,287	1	6,287	7,457	,007
Within Groups	84,302	100	,843		
Total	90,588	101			

Source: Own data collection and editing, 2022

The result of the correlation variable shows that there is a correlation between the values (p=0.007), i.e. there is a correlation between the gender of the students and the difficulty of interpreting IT data.

Regarding the results, there is a higher proportion of students who have difficulty in using IT software, which is why I asked the following question: how important do they think IT

education is in school and do they want to learn more about IT? The results are illustrated in Figure 43.

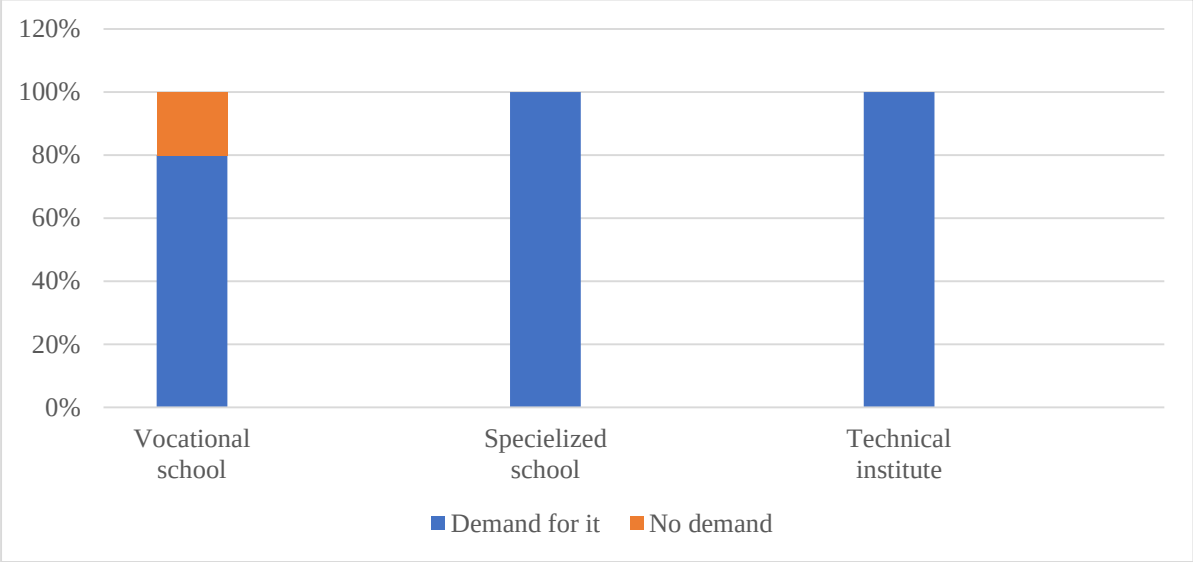


Figure 43

To what extent is there a need to expand IT knowledge?

Source: Own data collection and editing, 2021

It is impressive that students, based on the results of the first two questions, recognise the gaps in their knowledge of IT and feel the need to develop their studies. During the lessons, the students said that they had - and still have - IT lessons, but that their knowledge is superficial and that there was not enough time to expand it sufficiently. They only use the facilities provided by the computer for their own purposes, which include playing computer games and visiting social networking sites.

I also asked about the extent to which they attach importance to and accept the necessity of the knowledge I have presented, which is essential for further understanding of economic relations. The results are presented in Figures 44 and 45.

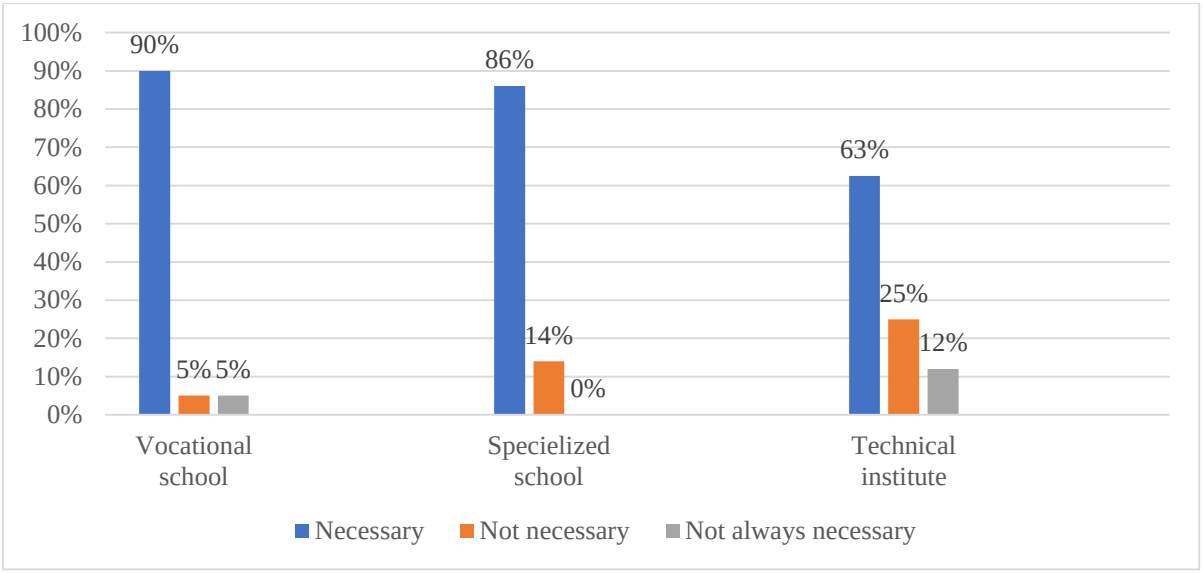


Figure 44

Acceptance of" background information" among students to process the new curriculum

Source: Own data collection and editing, 2021

In preparing the lesson, the main focus was to avoid traditional methods and to use ICT tools as much as possible. Unfortunately, due to the change of circumstances (secondary and university education had to be delivered online), a repetitive lesson systematising the theoretical background information necessary to understand the simulation method could only be delivered in a traditional way, in a frontal classroom setting. The difficulty of teaching economic concepts, lexical knowledge, analyses and interrelationships makes it difficult to arouse interest in the subject matter, and the view expressed in the answers to the question on the importance of theoretical knowledge that all three subjects felt the need to provide background information was not the expected result.

Since the simulation was presented in three different classes - the further question was to explore what had been learned so far.

I was looking for an answer to the question whether there is a correlation between the types of schools and the comprehension of the analyses. Students were asked to select one of five options in response to the questions.

1- yes, completely

2- rather yes

3- rather no

4- no

5- don't know

The results of the tests between the responses are shown in Table 16.

Table 16.
Level of understanding of economic analysis by type of school

school type * understandability Crosstabulation

Count

		Contact					
		1	2	3	4	5	Total
iskola típusa	1	11	22	12	6	1	52
	2	5	12	12	0	0	29
	3	10	9	2	0	0	21
Total		26	43	26	6	1	102

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	17,021[a]	8	,030
Likelihood Ratio	19,228	8	,014
Linear-by-Linear Association	7,252	1	,007
N of Valid Cases	102		

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,408	,030
	Cramer's V	,289	,030
N of Valid Cases		102	

Source: Own data collection and editing, 2022

As can be seen from the data in Table 16, more respondents marked answers that focused on understanding the information, 69 in total, than those who did not or only partially understood economic analysis.

I found no significant correlation between the types of school and the comprehensibility of economic analyses, the p' value is greater than 0.05 in all cases, so there is no correlation for the variables under study, although I assumed that students who have attended vocational schools have difficulty in comprehending the context.

Surprisingly, more than half of the students in vocational education are receptive to this type of knowledge and only 10% of the students have difficulties in interpreting it, in light of the fact that students in this type of education scored below average on competency assessments.
Graph 45 presents a detailed analysis of the vocational secondary school class in terms of the distribution between boys and girls. When the categories "understand" and "mostly understand" are combined, 73% of boys and 57% of girls know economic analysis and relationships.

Table 17.
Frequency test results for understanding economic analysis

Statistics

Accessibility

N	Valid	102
	Missing	71
Mean		2,15
Median		2,00
Mode		2

Accessibility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	26	15,0	25,5	25,5
	2	43	24,9	42,2	67,6
	3	26	15,0	25,5	93,1
	4	6	3,5	5,9	99,0
	5	1	,6	1,0	100,0
	Total	102	59,0	100,0	
Missing	System	71	41,0		
Total		173	100,0		

Source: Own data collection and editing, 2022

The data in the table show that the second response, "more understanding" of the link between economic analysis and the curriculum, was the most popular. In the analysis the mode value = 2, the response means = 2.15 and the median = 2.

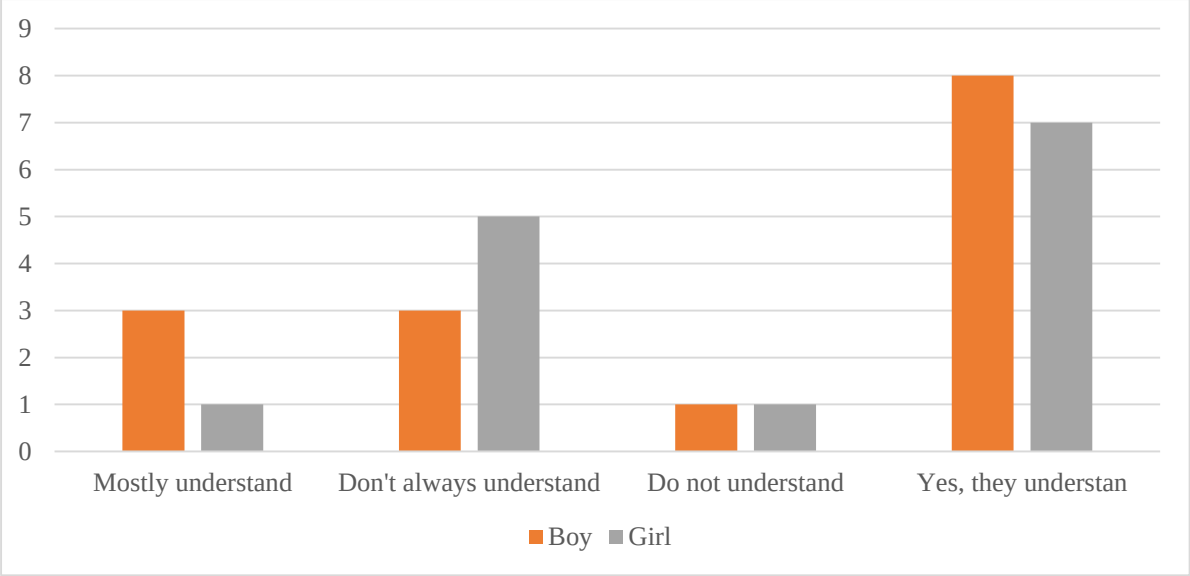


Figure 45

Comprehensibility of economic analyses in upper secondary school in relation to boys and girls

Source: Own data collection and editing, 2021

I also encountered difficulties in the areas of accuracy of knowledge of basic concepts, but these differences can also be attributed to the differentiation of subjects and subjects resulting from the training. These basic concepts were not encountered by 25% of students in upper secondary vocational education, 14% of students in vocational education and 13% of technicians during their studies. Half of the students in vocational education and training, 45% of those in vocational education and training and 37% of technicians did not identify all the categories they had encountered. Among the benefits of the simulation method, it is important to highlight the fact that 35% of vocational students, 15% of technical students and 13% of technical students answered that they understood the concepts and the context with the help of the simulation.

The primary goal of the simulation was to create a pedagogical method in which students' thinking, understanding and correct application of economic concepts and contexts can be developed and shaped. In the light of the results, we can say that the simulation model used in animal husbandry meets our requirements.

The questions on the novelty and usefulness of the method received positive feedback from almost all classes. The responses are illustrated in Figures 47 and 48.

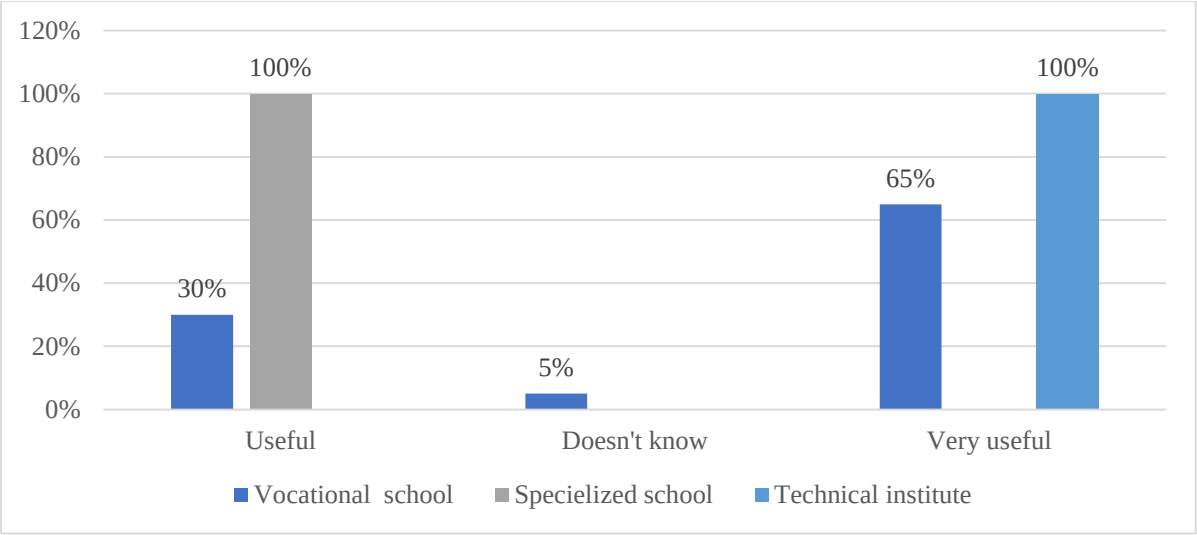


Figure 46

The extent to which the method is considered useful

Source: Own data collection and editing, 2021

The answers useful and very useful were chosen by a significant majority of students in both the technical and vocational classes, while 5% of students in the vocational classes could not decide on the basis of the answers given whether the model was useful in everyday life. The innovation of the method I have described was identified as innovative by 100% of the students, with the exception of the technical class, while three students from this class had already encountered the method in their practice. In my research, I hypothesized that there is a correlation between the type of school and the perception of the new curriculum I described, so I conducted further research to support my hypothesis. The results are shown in Table 18.

Table 18.
Level of understanding of economic analysis by type of school

type of school * whether the new knowledge is useful Crosstabulation

Count

		whether the new knowledge is useful				
type of school		1	2	3	5	Total
	1	20	28	2	2	52
	2	19	9	0	1	29
	3	20	1	0	0	21
Total		59	38	2	3	102

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	21,555[a]	6	,001
Likelihood Ratio	25,668	6	,000
Linear-by-Linear Association	12,391	1	,000

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,460	,001
	Cramer's V	,325	,001
N of Valid Cases		102	

Forrás: Saját adatgyűjtés és szerkesztés, 2022

There is a strong significance between the type of school and the perception of new knowledge, as p'=.001, but there is only a loose relationship between the data, as Cramer'sV=0.325.

A very significant challenge for teachers in teaching in the spirit of the times is to keep students' attention while processing the material, to maintain motivation throughout the lesson, while maintaining the discipline necessary for effective work. So, in conclusion, I asked our students to give their opinions on the extent to which the lesson I had put together was interesting or boring for them.

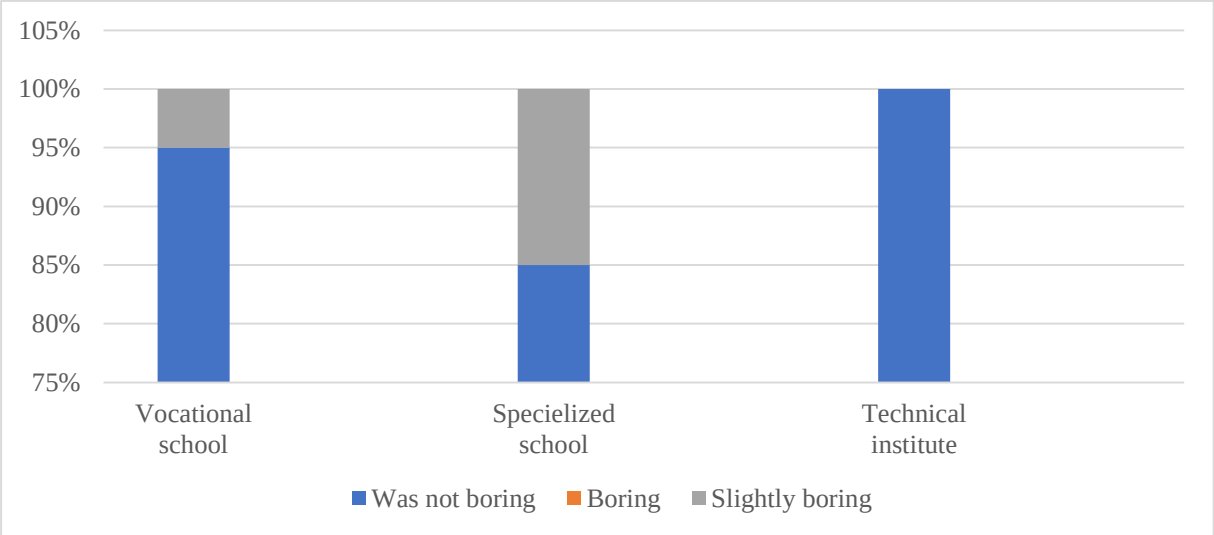


Figure 47

To what extent do you find the lesson interesting?

Source: Own data collection and editing, 2021

One of the major challenges for teachers in teaching in the spirit of the times is to keep students' attention while processing the curriculum, to maintain motivation throughout the lesson, while maintaining the discipline necessary for effective work. So, in conclusion, I asked our students to give their opinions on the extent to which the lesson I had put together was interesting or boring for them. Analysing the answers, our students in the technician course unanimously rated the lesson as interesting and effective, while the students in the other two courses included some who found some parts boring, but they also found the use of the model interesting and effective. The boring parts were clearly seen in the theoretical, systematic lesson using the frontal class work method, but the lesson using the innovative method was also a positive experience for them. These responses also clearly reflect our initial assumption that traditional pedagogical methods are not sufficient to prepare students of today for exams.

4. CONCLUSIONS

Vocational training in agriculture is a key element in the development of the agricultural sector, as its fundamental task is to equip students with up-to-date theoretical and practical skills that will enable them to compete internationally. The technological advances and developments in agriculture, the shrinking number of children and the diversity of their competences are a major challenge for teachers in carrying out their work. In my opinion, there is a need for a major overhaul in secondary agricultural education, and I have therefore mapped out the pedagogical methods and tools that can be used in agricultural vocational schools, the results of which are as follows.

1. Pedagogical practice is mostly dominated by teaching methods that can be considered traditional, such as individual work, presentation, explanation, discussion. New generation methods - group work, case studies, modelling, games, project work and assessment, cooperative and competitive methods - are less common among teachers' teaching tools, and the use of new generation methods in pedagogical practice is decreasing as the number of years of teaching increases.
2. A similar trend can be observed in the use of educational tools. A lesson using a projector and a laptop in a frontal classroom setting cannot be considered as an innovative ICT-based lesson. Although ICT tools are fully known by teachers, only half of them are used in everyday practice, and they are mainly used by the younger generation of teachers, who do not naturally have to do more work in preparing or delivering lessons with innovative teaching tools.
3. To a small extent, but with predictive value, there is a trend towards the use of smartphones in the classroom. Against this background, it would be worth considering the development of applications that can be run on smartphones and used by students in lessons or at home, alongside teacher instructions.
4. In the teaching-learning process, the role of IT tools in education is clearly growing, and only fully trained teachers can successfully use them. Thus, more emphasis should be placed on training teachers and broadening their knowledge in a number of areas. In view of the situation created by Covid -19, it is likely that in the near future it will be impossible to provide traditional training, and consideration should be given to setting up Internet portals and online platforms for teachers to prepare themselves individually.

In addition to attending training courses, the institution's IT equipment should also be highlighted, as the lack of appropriate tools can affect the effectiveness of teaching. More than

half of the respondents were satisfied with the availability of teaching tools. However, the fact that the majority of teachers use projectors and laptops in their work should also be taken into account. To a lesser extent, multimedia tools and visual aids are used.

5. Despite the fact that a significant proportion of pupils have difficulties in using ICT tools, according to teachers, ICT-based lessons are more successful for pupils and have a positive impact on pupils' skills, abilities and learning.

6. Simulation methods and programmes used in agricultural education are considered by the respondents as equivalent to visualisation tools in the traditional sense, and only a few are aware of the meaning of simulation models.

The primary objective of the dissertation was to develop an innovative pedagogical method to develop students' cognitive skills, to develop an economic system thinking and to encourage them to learn more about the profession. The simulation method developed by me was presented in November 2020 at the Móricz Zsigmond Agricultural Technical School in Kaposvár, in the classes taught by me, which were selected according to the training courses conducted at the school.

The following conclusions and recommendations were drawn from the simulation model:

1. The use of simulation models also requires teachers to have considerable IT skills, so more emphasis should be placed on teaching pedagogical methods based on ICT tools in teacher training.

2. The successful use of simulation models also requires a lot of prior knowledge, which, in order to map and prepare the use of the model chosen by the teacher, requires a lot of extra work for the teacher, but overall, the use of simulation models in the classroom has a number of advantages, according to the respondents, such as maintaining attention, motivation and practical applicability of the model.

3. A factor affecting the success of the method is that the simulation model can only be used with the right infrastructure. Thus, it is necessary to solve the current lack of IT tools and keep them up to date in vocational schools.

4. My research has clearly shown that by using innovative pedagogical methods that create an experiential effect on students, it is possible to deliver more successful and effective lessons.

5. In Hungarian agriculture, too, there has been a level of development that neither teacher training nor vocational training can keep up with, and as a result it is not possible to teach in the same way and in the same way as before. A major overhaul of secondary agricultural

education is needed. One of these areas is the renewal of technical and IT training, and the further training of teachers is also essential to ensure quality education.

As a result of the observations made on the farm and the evaluation of the simulation model, the following conclusions were reached.

1. The most important of the reproductive performance indicators of sows is related to reproductive performance, which can be evaluated by the number of farrowing's and the number of piglets farrowed. There is a significant difference between on-farm data and the indicators reported in the literature, and it is therefore justified to recommend improvements and investments for further effective management. In particular, the introduction of technological innovations and the introduction of species replacement could provide a solution to improve the low reproduction rate.

2. When the simulation results are approached from an economic perspective, a difference in turnover can also be observed between the results of the two simulations. The simulator-driven process has shown a significant increase in reproduction, which therefore has an impact on the evolution of turnover.

3. A comparison of the results of the simulations carried out shows that there are significant differences in their use in economic calculations. While the "MC" method does not involve changes in the number of animals and is therefore only suitable for mapping the distribution of the herd over time, such as predicting certain birth peaks in the case of synchronised breeding, the individual-driven simulation based on the theoretical basis of the method also involves changes in the number of animals, which also affects the calculation of income-generating capacity.

4. Examining the data and simulation results reveals significant problems in the pre-election mortality values. While in the general scientific literature a mortality rate of 2-6% is considered to be average, in the farms I studied this figure exceeded 16%, which is considered to be a very high rate.

5. The reason for the high mortality rate before the piglet selection was mainly due to technological deficiencies and the poorer rearing ability of the sows, as evidenced by the fact that the causes of piglet deaths in the farms I studied were mainly due to crushing and trampling, which can be avoided by proper cuticle design and by the removal of nervous, difficult-to-handle sows. About 15% of the piglets died as a result of infection, a disease caused by the diarrhoea-causing bacterium E. coli, a smaller proportion (10%) died as a result of low birth weight and 2% died as a result of physical injuries.

The hypotheses raised in the research were accepted or rejected following the literature review and in the light of my findings:

1. My first hypothesis, that teachers in agricultural vocational education are only less aware of the benefits of using ICT tools in practice, was rejected, as the research results proved that ICT tools are fully known by teachers, although only half of the teachers integrate their use into their daily practice.
2. My second hypothesis was accepted, as the results show that the use of innovative pedagogical methods based on ICT tools is predominantly widespread among the younger generation of teachers, while the older generation mainly uses traditional tools and methods in their work.
3. My third hypothesis was rejected, as the survey showed that more than half of the respondents were satisfied with the ICT tools in their school, but it should also be taken into account that a higher percentage of teachers only use projectors and laptops in their work. The use of multimedia tools, visualisation models or smartboards has been pushed into the background and should not be missing from the technical toolbox of teachers in their institution.
4. My fourth hypothesis was supported by both the scientific literature and my own research and proved that students have difficulties in using ICT tools in learning
5. My fifth hypothesis has been fully proven, namely that in order to meet the requirements of the modern age, knowledge of computers and IT tools is necessary and therefore training in this area needs to be organised.

5. NEW RESEARCH RESULTS

The rapid IT and technological developments in the world are having an impact on the agricultural sector. The introduction of technical and technological innovations into the production processes has become a basic requirement for innovative and economical agricultural production.

Such changes can also be seen on the demand side, as entrepreneurs and businesses are increasingly looking for workers with a background in IT and innovation technologies.

These expectations must also be taken into account in the education of vocational and technical schools in agriculture, as our task is to train professionals during their school years who can find their place in the labour market in any situation.

In view of the requirements of the present age, I consider it necessary to renew the innovative teaching of agricultural training, making greater use of ICT tools.

In view of the above, I have formulated the following new scientific results in my research:

1. Although traditional pedagogical methods are still the base of education in the agricultural secondary and vocational schools of the South Transdanubian region, innovative technologies and IT-based education are not far behind. Both at institutional and teacher level, they are open to the use of innovation in the learning-teaching process.
2. It has become clear that not only changes in teaching surfaces and methods are needed, but that this process needs to be supported by a major change in IT training for students.
3. Among the pedagogical methods, one possible way of teaching innovation content, vocational and IT education is to use simulation models in pedagogical practice, which make the understanding of the interrelationships between subjects, economic analyses and concepts clear to students.
4. Although teachers are not familiar with the use of simulation models for educational purposes, many of them identify it with modelling or the creation of models, but they do not exclude the use of this type of teaching method.
5. A significant achievement is the creation of a simulation model, similar to which is used in different areas of the economy as an efficiency increasing and management system, but in the field of agriculture, for educational purposes, no such program has been created.
6. Not only can the simulation model be used for educational purposes, but it can also help the farmer in everyday practice in a number of areas, both in determining herd distribution,

calculating turnover and cost efficiency, and in determining the quantity of feed and other supplements.

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