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Analysis of Communication in the Educational Process by Means of E-Learning

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Abstract:

Purpose: *The aim of the research is to analyse communication in the educational process by means of e-learning.*
Approach/Methodology/Design: *An analysis of relevant foreign literature was conducted. A communication model and a comparative analysis of synchronous communication tools based on established criteria were indicated. For the comparative analysis normal distribution, descriptive analysis methodology and chi-quadrate distribution with T-student distribution were used.*
Findings: *The analysis of the presented research results shows that most respondents prefer to solve tasks at a distance in any form. Students are satisfied with the adopted solutions, as well as with the offered methods of communication. The introduction of e-learning positively influences the acquisition and dysfunction of knowledge by students.*
Practical Implications: *Distance communication is a very popular means of communication in the 21st century. The use of various tools does not create a barrier and is evidence of high technological progress.*
Originality/Value: *An original literary approach from the most recent international positions was presented and authorial research was carried out on a representative group of respondents. It is shown that the transfer and acquisition of knowledge by means of information and communication technologies has contributed to changes at universities.*

Keywords: *E-learning, process, education, communication.*
JEL codes: *D83,C32,A20, D83.*
Paper type: *Research article.*

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1. Introduction

Universities are places where tradition meets modernity. Currently, this modernity manifests itself, among other things, in the need to adapt the way of teaching to the requirements of the knowledge-based society where information technology is ubiquitous. Today, the lecture hall is only one of many possible options for gaining knowledge, and given the traditional way of conducting lectures at many universities, manifested by the monologue of the lecturer, this option does not seem particularly interesting for the current generation of students, for whom the main environment of activity is the Internet, which allows not only to quickly find relevant information, but also to exchange it through communication technologies. All this makes the next generation of students attach increasing importance to non-formal education. Thanks to the use of Internet resources, lecturers have the possibility of polysensory teaching, which guarantees better educational results compared to traditional methods. There is no doubt, however, that one of the most important factors determining the success of e-learning education is effective communication between the participants of this process.

The rapid development of information and communication technologies and the increase in knowledge overnight have given direction to university didactics, which has recognized the benefits of combining the process of gaining knowledge with technology (Miciuła, 2018). This is how e-learning was created. As Aparicio and others explain (2015), the term "learning is a cognitive process for achieving knowledge, and technology is an enabler of the learning process, meaning that technology is used like any other tool in the education praxis, as is a pencil or a notebook, for example". Although the concept of e-learning itself did not appear until 1983 in Mary Alice White's article, the idea of using a computer to support the learning process was already being developed in the 1960s. Over the decades, a number of concepts combining technology and didactics have been developed, among them: CAI (Computer-Assisted Instruction), CBE (Computer-Based Education), CAL (Computer-Assisted Learning), LMS (Learning Management Systems), CMI (Computer-Managed Instruction), CAE (Computer-Assisted Education), m-Learning (Mobile Learning), SRE (Self-RegulatoryEfficacy), CSCL (Computer Support for Collaborative Learning). Newer ideas include MOOC (Massive Open Online Course), LOOC (Little Open Online Course), SPOC (Small Private Online Course) (Aparicio *et al.*, 2015). The differences between the different concepts are shown in Table 1.

2. Literature Review

Progress in the functioning and use of e-learning systems has contributed to the introduction of significant changes in the way of teaching at universities (Clark and Mayer, 2011; Martel, 2015; Wagner *et al.*, 2008; Zondiros, 2008), although not in every country the development of online courses was an easy process (Weber and

Hamlaoui, 2018). In Japan, for example, the full acceptance of e-learning had to wait until 2000. The reasons for this are explained by Nakayama and Santiago (2004): "In 2000. The University Council of the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) began to consider e-learning (including asynchronous format) as a different way of teaching and conducting courses. As MEXT continues to retain the authority to approve and accredit university programmes, e-learning programmes and institutions must ensure that their courses meet the guidelines and conditions of MEXT (e.g. number of credit hours for each course).

Table 1. *Selected concepts based on e-learning*

Acronym	Description	Concept Focus
CAI	Computer-Assisted Instruction	Computer usage focused on programming teaching used in various fields: mathematics, engineering, psychology, physics, business administration, statistics.
CBE	Computer-Based Education	Concept that focuses on the variety of computer uses in education.
CAL	Computer-Assisted Learning	Focused on individuals rather than tasks. The use of computers to assist problem-solving.
LMS	Learning Management Systems	Supports registering services, tracks and delivering content to learners. It also reports learner progress and assessing results. LMS focuses on contents and teacher/student interaction.
CMI	Computer-Managed Instruction	CMI stresses the teacher´s tasks.
CAE	Computer-Assisted Education	CAE concept refers to the use of computer for materials' production and focuses on the students'use of the computer in learning
m-Learning	Mobile Learning	The first way to fight illiteracy. (…) m-Learning is the focus of flexibilization in the learning class environment and the use of various learning sources.
SRE	Self-RegulatoryEfficacy	Concept focused on learner's independent assessment of self-regulatory learning ability.
CSCL	Computer Support for Collaborative Learning	Concept that focuses on computers as a way to facilitate, augment, and redefine support learning in groups.
MOOC	Massive Open Online Course	Free diffusion of content courses to a global audience through the Web. Integrates the connectivity of social networking, the Facilitation of an acknowledged expert in the field of study, and a collection of freely accessible online resources.
LOOC	Little Open Online	Focus on the directed instructions from the teacher to the students.
SPOC	Small Private Online Course	MOOC usage as a supplement to classroom learning, not as a substitute to the traditional way of teaching.

Source: *Aparicio et al., 2015.*

Other current developments include the growing number of Japanese government e-learning projects, one national initiative called E-Japan, and the adoption of an IT policy to help promote the use of e-learning in Japan. These institutional changes are significant because MEXT has always been authorised to certify academic

programmes, and historically, MEXT has only granted accreditations to courses that have been delivered in person. It is a tradition that has made e-learning, and even vocational training and continuing education, immediately take off in the Japanese education system".

E-learning understood as, in general, the transfer and acquisition of knowledge by means of information and communication technologies (Sambrok, 2003) contributed to the development of a new culture of learning because, as Bonk wrote (2009), "we have stepped into a new culture of learning where we assume radically new perspectives of ourselves as learners and what it means to participate in the learning process. The culture is one of participation and personalization". Online courses are a standard form of courses offered at universities in the 21st century, as more and more people have access to the Internet, use a computer on a daily basis and have better computer skills (Huynh *et al.,* 2003; Jałowiec *et al.,* 2020). The development of this form of teaching is also supported by frequent human interaction with information through devices such as mobile phones or tablets (Miciuła, 2016; Wojtaszek and Miciuła, 2019). According to Nganji (2008), "yungerfolks nowadays tend to spend a considerable amount of of time interacting with their devices and intercommunicating (Miluniec and Miciuła, 2019). By so doing, information is being transmitted and knowledge is gained".

Valle and Duffy (2009) emphasise that also from the point of view of universities, online courses are an attractive market offer, as the increase in the number of students choosing this form of education does not mean that there is no need to increase the space available for teaching (in other words, universities can accommodate more students without having to invest in the expansion of existing buildings). Moreover, thanks to online courses, universities can encourage candidates who, for various reasons (e.g. childcare, full-time work, caring for an older family member) would not decide to study in the traditional form (Yamagata-Lynch, 2014). Currently, at many universities around the world, online courses effectively compete with traditional forms of classes, although research to date does not confirm unequivocally which form of classes allows students to achieve better results (Bertus, 2006; Brown and Liedholm, 2002; Farinella, 2007). On the other hand, McPherson and Bacow (2015) claim that today it would be difficult to find classes conducted in a fully traditional way, if only because most lecturers and students communicate via e-mail. As the authors conclude, "While students may not be formally enrolled in "online courses," the influence of digital content in the academy is ubiquitous".

The outbreak of the coronavirus epidemic has undoubtedly accelerated the pace of systemic changes, which should also take place at Polish universities in the field of conducting online classes years ago. It is worth noting that several years ago, for similar reasons, the potential of e-learning was appreciated in China when, as a result of the SARS epidemic, educational institutions were closed down, so that university

classes continued online (Feiyu and Gilsun, 2007). Although e-learning is an attractive method of education, the subject literature discusses not only its advantages but also its drawbacks (Table 2). Perhaps one of the biggest weaknesses of online teaching was indicated by Reif (2013): "For all the strengths of today's digital technologies, however, we know that some things-perhaps the most important elements of a true education-are transmitted most effectively face-to-face: the judgment, confidence, humility and skill in negotiation that come from hands-on problem solving and teamwork; the perseverance, analytical skill and initiative that grow from conducting frontline lab research; the skill in writing and public speaking that comes from exploring ideas with mentors and peers; the ethics and values that emerge through being apprenticed to a master in your field and living as a member of a campus community". The literature also draws attention to health problems affecting online course providers, such as emotional stress caused by isolation and loneliness or a higher risk of burnout compared to traditional lecturers (Dolan, 2011; Hogan and McKnight, 2007; Smith *et al.*, 2015).

Table 2. *Traditional classroom learning vs. e-learning (Zhang et. al., 2004)*

	Traditional Classroom Learning	**E-Learning**
Advantages	• Immediate feedback • Being familiar to both instructors and students • Motivating students • Cultivation of a social community	• Learner-centered and self-paced • Time and location flexibility • Cost-effective for learners • Potentially available to global audience • Unlimited access to knowledge • Archival capability for knowledge reuse and sharing
Disadvantages	• Instructor-centered • Time and location constraints • More expensive to deliver	• Lack of immediate feedback in asynchronous e-learning • Increased preparation time for the instructor • Not comfortable to some people • Potentially more frustration, anxiety, and confusion

Source: *Own study.*

Among the reasons for expanding the e-learning educational offer one can mention, among others, facilitating access to educational materials, cost reduction, preparing students to participate in the knowledge-based society, as well as flexible response to the demand of the labour market and the possibility of cooperation between representatives of science from different corners of the world (Dolence and Norris, 1995; The future, 2008). An important advantage of online education is also the possibility of quick and easy modification of the presented content, which is particularly important at the current pace of changes taking place in the environment. Mazzarol, Hosie and Jacobs (1998) already a dozen or so years ago drew attention to the fact that on the educational market effective use of information technologies will be one of the sources of competitive advantages, which is connected, among others,

with the possibility of personalizing the transfer of knowledge by taking into account different styles of students' learning (Palloff and Pratt, 2003; Kolb and Kolb, 2005; Bhattacharyya, 2014). It is worth remembering Riding's observation (2005) that students are not the same and that the way they learn as well as their scientific success depends on these individual differences.

However, this diversity includes not only learning styles understood as a way of receiving and processing information, but also the approach to learning and the level of intellectual development (Felder and Brent, 2005). Moreover, in a globalised world, it should be remembered that classes are attended by representatives of different cultural backgrounds, and culture is one of the most important factors shaping the way information is received and processed and thus knowledge is acquired (Sywelem *et al.*, 2012). With this in mind, academic teachers should make every effort to meet the different expectations and needs of students in the preparation of e-learning courses in order to arouse their interests and motivate them to learn (Felder, 2010). However, at this point, there is a problem which is difficult to overcome, namely that the materials for online courses are prepared before the lecturer meets with the students, and therefore it is not possible to modify them properly in order to personalize the knowledge transfer at the moment of learning. However, it is difficult to agree with such a statement, given that (Zając, 2006):

- the individualization of the learning process begins at the place and moment of starting the learning process, which means that just enabling the student to decide where and when he wants to start and then continue his learning is a manifestation of personalization of the knowledge transfer,
- personalisation can also mean freedom of movement in the presented material,
- the individualisation of the teaching process may also manifest itself in the inclusion of different levels in the presented material; this is particularly important in the case of courses prepared for master's students in a situation where some participants have not completed undergraduate studies dedicated to a specific educational programme,
- one of the more advanced methods of individualizing the teaching process is to diversify the form of the content presentation by means of different methods: it can be a traditional lecture prepared in the form of a text enriched with audio and video recordings, or it can be a lecture given by a lecturer.

Decelle (2016) recalls that an important feature of the teaching process of adults is the possibility of negotiating selected aspects of education, so that course participants are given the opportunity to co-decide on the topics covered by the course. Thus, they take responsibility for the effectiveness of the teaching process and willingly engage in the tasks performed during the course. An inseparable element of individualization of the teaching process is the way of communication accompanying the classes conducted online. This element becomes particularly important when we realize how knowledge is acquired according to constructivism (rooted in American education

theory) (Bächtold, 2013; Clarà and Barberà, 2013; Ertmer and Newby, 2013; Magnussen, 2008). As Zhu (2008) explains, "based on constructivist learning theory, knowledge is constructed by learners through internal processes, such as accommodation and assimilation and the interactions with each other and with the environment in which they live".

In a similar way, the learning process is explained by Nganji (2008), placing greater emphasis on the meaning of the senses and the interaction of the individual with information: "Individuals by interacting with others or with information get involved in a process of discovery where they find out new information they had not knownbefore or understand better what they knew. Usually,this is done using the senses. The sense of sight forinstance could be used to watch videos, read informationin print or online or to make an observation which results in knowledge".

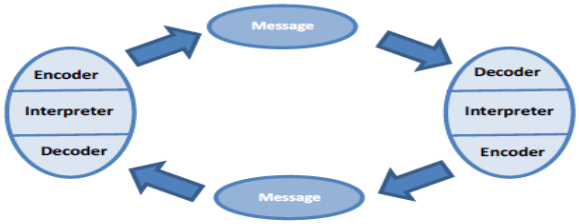
From the above it should be concluded that one of the most important tasks of a lecturer is to organize such an educational environment in which students will be encouraged to exchange and confront views (Gräsel *et al.*, 1997, Brook and Oliver, 2002). Farooq and Matteson (2016), referring to Brookfield and Preskill (1999), stress that by participating in the discussion, students benefit from a number of advantages, as they can then:

- explore a diversity of opinions
- raise their awareness of and tolerance for ambiguity or complexity
- recognize and investigate their assump-tions
- become attentive, respectful listeners
- appreciate continuing differences
- increase intellectual agility
- connect to a topic
- respect other voices and opinions
- learn democratic discourse
- become co-creators of knowledge
- develop capacity for clear communication of ideas
- develop habits of collaborative learning
- become more empathic
- develop skills of synthesis and integration.

Paechter and others (2013) note that in the case of online communication it is easier to overcome certain inhibitions that make it difficult to participate in discussions or group work in case of face-to-face contact. On the other hand, it is emphasized that online communication via text channels (e-mail, Internet forums) is poorer by the whole spectrum of non-verbal means of communication (such as eye contact or facial expressions), which makes it difficult to obtain information about the mood of the interlocutor, for example (Schweizer *et al.*, 2001). Communication between the lecturer and students goes beyond a simple form of dialogue and, apart from the exchange of ideas, also plays an important role in the stage of presenting and

explaining the content taught, motivating and building mutual relations between the group members and the lecturer, as well as between the participants themselves (Brophy, 1999; Johnson *et al.*, 2008). At the same time, it should be remembered that the decoding of information received depends, among other things, on the individual experience of the participants in the online activities (Figure 1). According to the Schramm model, the sender sends a message, but it is up to the recipient to decide how to understand it. The special role of communication in the educational process is therefore that participation in a discussion makes it possible to check and respond to the knowledge acquired as well as to show other points of view (Kerres, 2000). Schulmeister (2006, cited after Bäuml-Westebbe, 2011) emphasises that in the process of dialogue, participants receive feedback, which is a prerequisite for learning, as it is through feedback that the material is understood.

Figure 1. *Schramm's Model of Communication*



Source: *Own study.*

Taking into account the development of a wide range of forms of communication via computer, a number of criteria for the division of these forms can be distinguished. Murray (1997) made a division into unilateral and interactive forms of communication. In the case of one-sided forms of communication, the sender does not address the statement directly to a particular recipient, nor does he expect the recipient to react to his statement. Interactive communication, on the other hand, involves the participation of at least two people who interact with each other. Interactive forms of communication can be divided into synchronous and asynchronous forms. Synchronous forms enable the participants of a conversation to communicate in real time, which requires the availability of all the participants of the conversation at the same time, while in the case of asynchronous forms the recipient's reaction is postponed (Chen *et al.*, 2005 Hrastinski, 2008, Weller, 2007). The different forms of synchronous and asynchronous communication with their potential uses and limitations are presented in Table 3.

Other criteria for dividing up forms of e-learning may relate to the place of learning, independence in the performance of a task or the use of materials provided through information technology (Wagner *et al.*, 2008). Brunken (2019) points to four levels of interactivity in online learning, underlining that it is sometimes better for learners to give up creative ideas in favour of a simple way of transferring knowledge (Rose,

2015). At level one, the course participant is not able to interact with the content, nor does he receive any feedbacks.

Table 3. *Usability and limitations of synchronous and asynchronous communication tools (Lim, 2017)*

Synchronous Communication Tools		
Communication Tool	**Usability**	**Limitations**
Video Conferencing	Real time interaction. Seeing the person that you are communicating with can give important visual clues.	Quality is dependent on bandwidth. There may be short time lag between speaking and receiving a response that can disrupt the natural flow of a conversation. Documents and other presentations can only be shared through the presenter's camera.
Web conferencing	Real time interaction. Permits sharing of presentation, documents and application demonstration.	Quality is dependent on bandwidth. There may be short time lag between speaking and receiving a response that can disrupt the natural flow of a conversation.
Audio conferencing	Real time interaction. Collaborative discussions that involve certain number of people.	Quality is dependent on bandwidth. There may be short time lag between speaking and receiving a response that can disrupt the natural flow of a conversation. Does not incorporate visual learning.
Live chat	Real time interaction. Text and graphics capabilities are available for Information sharing of low-complexities. Provides documentation of student interaction.	Mostly text based and as such slows down communication rate. May lead to misinterpretation of expressions.
White boarding	Real time interaction. Demonstration and co-development of ideas.	Bandwidth based, and at times effective with audio conferencing.
Application sharing	Real time interaction. Demonstration and co-development of documents.	Bandwidth based, and at times effective with audio conferencing.
Asynchronous Communication Tools		
Discussion forum	Collaboration and sharing of ideas can be made over a certain time period. More time for reflection on the topic of discussion. Easy to form and control the level of participation.	May lead to misinterpretation of other people's ideas. May take longer to have feedbacks.
Web logs	Dissemination of ideas, comments, images and other documents is easy and open to all. More time for reflection on the topic of discussion. Provides documentation of student interaction.	May lead to misinterpretation of other people's ideas. May take longer to have feedbacks. May require technical knowledge in forming web logs.

E-mail messaging	Distribution of course materials on one-to-one or one-to-many basis. Privacy in communication.	It is difficult to get instant reply to mails especially with large classes.
Social media messaging	Message delivery such as important announcements. Group chat may serve as discussion forum. Personal messaging may be utilized by the teacher for mentoring purposes. Provides documentation of student interaction.	If the receiver is not online, you will have no immediate feedback. Difficult to control the level participation. Messages in the group chat cannot be deleted, thus bad or unnecessary participations can't be controlled.

Source. *Own study.*

His task is to familiarise himself with the information he receives in various forms. It can be a text, an image, an audio recording. At the second level, the presented content uses educational solutions that enable simple interaction between the participant and the presented material, thanks to which the participant actively participates in the learning process. These are different kinds of tasks, such as dragging elements or sorting the content. They can also be links to external resources. At this level of interactivity, the participant has the opportunity to check his/her knowledge and receive feedback based on the exercises performed.

At the third level, more complex interactions are used to give the course participant even more control over the learning process. "Participants can take advantage of simple branching pathways to participate in dynamic experiences that meet their individual learning needs. Simulated activities, scenario-based case studies, moderate interactive exercises, and custom animations also enable participants to actively investigate and demonstrate concepts. Informative feedback and adaptive remedial instruction provide just-in-time guidance to address comprehension gaps". With educational solutions applied at level 4, participants have the opportunity to participate in the scenario and play a role so that they can explore new content when making decisions and looking for alternatives. At this level the participant takes full control over the learning process. However, regardless of the level of the participant's interaction with the delivered learning content, it should be remembered that the quality of online activities depends primarily on the quality and frequency of the feedback received from the teacher (Baker, 2010; Hart, 2012).

3. Research Analysis and Discussion

The analysis was carried out on the population of students who are in a crisis situation, i.e. forced to take classes in the e-learning form. The size of the student population taken into account was 950 of the surveyed respondents of the pulse school in Mazowieckie Voivodeship in March 2020.

The general population has a normal distribution $N(m, \sigma)$, where σ is known:

$$P\left(\bar{x}-u_{\alpha}\cdot\frac{\sigma}{\sqrt{n}}< \ m \ <\bar{x}+u_{\alpha}\cdot\frac{\sigma}{\sqrt{n}}\right)=1-\alpha$$

provided that
m - average,
σ^2 - variance,
σ - standard deviation,
p - percentage, percentage, fraction, frequency, structure index,
n – sample size.

For a population size of 950 people, the confidence level was set at 95% $\alpha = 0.95$, which means that at 95%, the number of people taking part in the study is 274. If we estimate that the feature is present in 60% of the population, give 0.6. If we do not know the value, give 0.5. In turn, the confidence interval for the fractional structure index (percentage of interval) of the p frequency is

$$P\left(\hat{p}-u_{\alpha}\cdot\sqrt{\frac{\hat{p}\cdot(1-\hat{p})}{n}}< \ p \ <\hat{p}+u_{\alpha}\cdot\sqrt{\frac{\hat{p}\cdot(1-\hat{p})}{n}}\right)=1-\alpha$$

assuming that p - percentage, population observation fraction.

In turn, the confidence interval for variance σ^2 has a normal distribution *N (m, σ)*

$$P\left(\frac{(n-1)\cdot\hat{s}^2}{\chi^2_{\frac{\alpha}{2},n-1}}< \ \sigma^2 \ <\frac{(n-1)\cdot\hat{s}^2}{\chi^2_{1-\frac{\alpha}{2},n-1}}\right)=1-\alpha$$

$\chi^2_{\frac{\alpha}{2},n-1}$, $\chi^2_{1-\frac{\alpha}{2},n-1}$ and the statistics are read from the chi- squared distribution. The maximum error tells us what "amendment" we should accept. In other words, when we assume an error of 0.03, or 3 percent, and carry out an election survey, when a given party gets 20 percent support, then with our assumption of the 3 percent error, the real support may differ by 3 percent. For the analysis of descriptive statistics, the distribution of the chi- squared $P\left(\chi^2\geq\chi^2_{\alpha,k}\right)=\alpha$
To the assumptions made in this way the assessment of the student's distribution was made t- the student's continuous probability distribution used frequently in statistics in procedures of testing statistical hypotheses and in the assessment of measurement uncertainty. When preparing the results of measurements, it is often a matter of estimating the interval in which the actual value of the measurand lies, with a certain probability, if we have only the results of n measurements, for which we can determine such parameters as the mean by assessing its density.

The variable T therefore has a Z/X distribution its density is therefore a form of:

$$f_T(t) = \int_{-\infty}^{\infty} |x| f_Z(xt) f_X(x)\,\mathrm{d}x = \int_0^{\infty} x f_Z(xt) f_X(x)\,\mathrm{d}x$$
$$= \int_0^{\infty} x \frac{1}{\sqrt{2\pi}} e^{-\frac{(xt)^2}{2}} \frac{2^{1-\frac{n}{2}}}{\Gamma\left(\frac{n}{2}\right)} n^{\frac{n}{2}} x^{n-1} e^{-\frac{n}{2}x^2}\,\mathrm{d}x$$
$$= \frac{n^{\frac{n}{2}}}{\sqrt{2\pi}} \frac{2^{1-\frac{n}{2}}}{\Gamma\left(\frac{n}{2}\right)} \int_0^{\infty} x^n e^{-\frac{1}{2}(n+t^2)x^2}\,\mathrm{d}x.$$

$$k-1 = \frac{n-1}{2} \Rightarrow k^* = \frac{n+1}{2}, \qquad \frac{1}{\theta} = \frac{1}{2}(n+t^2) \Rightarrow \theta^* = \frac{2}{(n+t^2)},$$

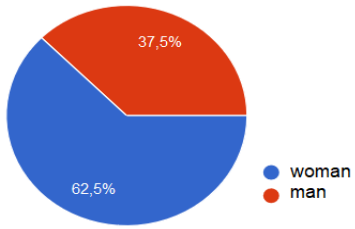
$$(*) = \frac{1}{2}(\theta^*)^{k^*}\Gamma(k^*) = \frac{1}{2}\left(\frac{2}{n+t^2}\right)^{\frac{n+1}{2}} \Gamma\left(\frac{n+1}{2}\right) = 2^{\frac{n-1}{2}} n^{-\frac{n+1}{2}} \Gamma\left(\frac{n+1}{2}\right)\left(1+\frac{t^2}{n}\right)^{-\frac{1}{2}(n+1)}.$$

Finally:

$$f_T(t) = \frac{1}{\sqrt{2\pi}} \frac{2^{1-\frac{n}{2}}}{\Gamma\left(\frac{n}{2}\right)} n^{\frac{n}{2}} 2^{\frac{n-1}{2}} n^{-\frac{n+1}{2}} \Gamma\left(\frac{n+1}{2}\right)\left(1+\frac{t^2}{n}\right)^{-\frac{1}{2}(n+1)} = \frac{\Gamma[(n+1)/2]}{\sqrt{n\pi}\Gamma(n/2)}\left(1+\frac{t^2}{n}\right)^{-\frac{1}{2}(n+1)}.$$

Figure 2 shows the share of respondents in the survey by gender.

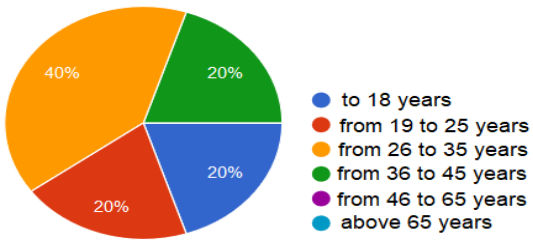
Figure 2. *Share of respondents in the survey by gender*



Source: *Own study.*

Figure 2 shows that women accounted for as much as 62.5% and men for 37.5%. The next Figure number 3 shows the share of respondents by individual age groups.

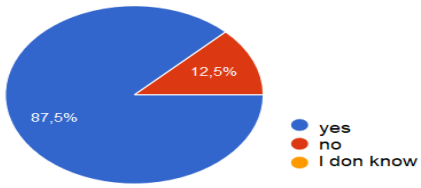
Figure 3. *Participation of respondents in the survey by age*



Source: *Own study.*

By performing the analysis on the basis of Pearson's linear correlation coefficient with the linear correlation coefficient where n<-1,1> n=0 or n<0, as a result n=0 no correlation was found between Gender and attitude towards changes in forms of education. The next Figure 4 shows the attitude towards changes in the form of education.

Figure 4. *Attitude to changing the form of education*



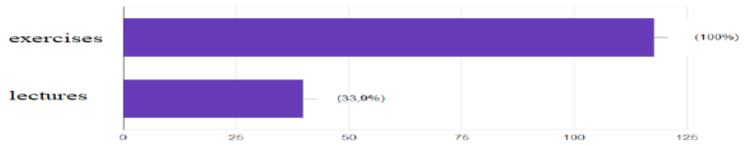
Source: *Own study.*

The majority (as much as 87.5% of indications) of the surveyed respondents show a positive attitude towards changing the form of education. On the other hand, 12.5% do not show a positive attitude. A chi-quadrant test was used to assess the analysis of gender correlation and decision making in terms of remote service preferences, where a hypothesis on the significance level was obtained α =0,01. The hypothses are:
H_0 the variables are dependent.
H_1 the variables are non-dependent.

$$\chi^2 = \sum_{i=1}^{k} \sum_{j=1}^{r} \frac{\left(n_{ij} - \hat{n}_{ij}\right)^2}{\hat{n}_{ij}}$$

The largest number of people who took part in the survey was 40% of those aged 26 to 35 years. Later on, equally, or more precisely 20%, people under 18, between 19 and 25, between 36 and 45 and over 65 took part. The study did not involve people between 46 and 65 years of age.

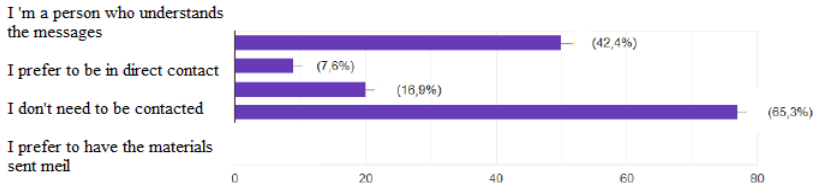
Figure 5. *The attitude of respondents who prefer service as a necessary exercise to lectures*



Source: *Own study.*

The surveyed respondents indicate that the most frequent form indicated in the even necessary contact is the form of conducted classes such as: 100% exercises and 33.9% lectures (Figure 5).

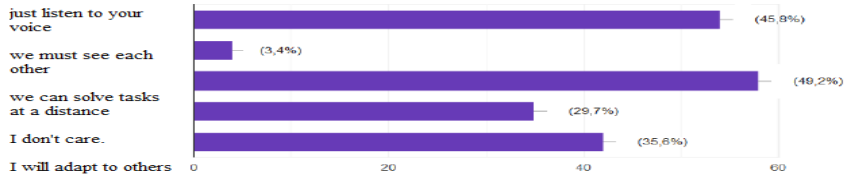
Figure 6. *Preferred possibility of contact in a crisis situation (no possibility of conducting classes personally)*



Source: *Own study.*

If it is necessary to have a form without the possibility of personal contact, students mostly as much as 65.3% would prefer to have the materials sent meilly, while 42.4% understand all the messages and are indifferent to it. 16.9% do not need to be contacted and 7.6% see no other possibilities, like direct contact (Figure 6).

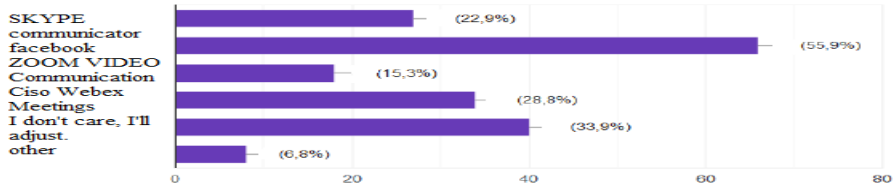
Figure 7. *Form of functioning in terms of contact issues*



Source: *Own study.*

As far as functioning is concerned, most of the respondents (as much as 49.2%) prefer to solve tasks at a distance in any form. In turn, 45.8% indicate that it is enough to hear only the voice. As much as 35.9% indicate that they will adapt to others. Only 3.4% of the respondents stated that a mutual opportunity to see each other is required (Figure 7).

Figure 8. *The form of the preferred tool to support remote learning*



Source: *Own study.*

It turns out that as a support tool, most respondents prefer facebook (as much as 55.9%). On the other hand, as much as 33.9% indicate that they do not care and will manage in any situation, while Skype 22.9% likewise 22.8% prefer Ciso Webex

Meetings and ZOOM VIDEO 15.3%. The respondents indicated the other 6.8% in the least way (Figure 8).

4. Conclusion

The introduction of e-learning at universities in Poland was dictated by conditions created by the outbreak of coronavirus. Although lecturers and students were largely unprepared for such a form of cooperation, most students are satisfied with the new form of education. It turns out that communication in the form of personal contact with the lecturer is in principle not important. Also during online classes, students do not pay much attention to the possibility of visual contact with the lecturer. The research also shows that social networks play an important role in the process of learning online, which is evidence of either poorly developed technical infrastructure at universities in terms of online courses, or the reluctance of the academic community to solutions proposed by universities.

As online courses have been forced by the threat of epidemics, research on e-learning in Poland should focus on answering the question of how online communication should proceed in order to benefit the main stakeholders of education at the academic level, i.e. lecturers and students. It is also worth exploring the barriers to conducting online courses, as well as factors encouraging students to participate in such classes. The analysis of the presented research results shows that the majority of respondents prefer to solve tasks at a distance in any form. Students are satisfied with the adopted solutions, as well as with the offered methods of communication with lecturers and other participants. The introduction of e-learning positively influences the acquisition and dysfunction of knowledge by students.

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