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Analysing the Teacher's Activity During Distance Lessons: The Aspect of Neurocognitive Processes

Abstract

The article presents four neurocognitive processes (excitation, perception, memorisation and using, transferring and adapting information and/or actions) during learning. Based on these processes, good learning can occur if the teacher chooses appropriate methods. The article presents an analysis of 28 distance lessons. The results show that active methods are most frequently used during the excitement process. In the process of perception, the verbal (questioning) method is used. While using, transferring, and adapting information and/or actions, the teacher applies various verbal methods and self-check tests to enable pupils to revise what they have learned.

Keywords: *neurocognitive processes, teacher's activity, distance lesson*

Introduction

The unexpected COVID-19 pandemic forced a reorganisation of the education system, directing particular attention to distance education. During this period, teachers faced new challenges related to concerns about maintaining high quality in distance education. They encountered various technical problems but showed great determination and creativity to find good solutions (Bergdahl & Nouri, 2021). Recognising the significance of teacher digital competencies in distance education, we would also like to draw attention to insights from neuroscience and how they can be used to teach pupils in this way.

According to researchers (Dubinsky et al., 2022), neurosciences do not directly provide new teaching or learning methods. However, knowledge of these sciences can provide teachers with a new awareness of the educational process and help them choose appropriate educational methods or tools. By understanding the physiological fundamentals of psychological phenomena related to education, teachers can gain valuable knowledge of how to organise the teaching and learning process (Dubinsky et al., 2022) so that the pupil can work effectively in the classroom in a contact or distance way and learn independently. The research shows that teachers with neuroscience knowledge have higher levels of self-efficacy, motivation, and responsibility for pupil performance (Brick et al., 2021). Knowledge in the neurosciences field has also been found to positively impact pupil-centred practice implemented by educators (Roehrig et al., 2012; Schwartz et al., 2019).

In the scientific literature of various fields related to the educational process, representatives of neuroscience increasingly offer information about the process of learning (Ekman et al., 2022). However, according to Mayer (2017), this knowledge is rarely applied. Learning results from the activity of the pupil's brain, a neurological process that can be analysed by answering the following questions: How does learning occur, and what factors can facilitate learning? (Donoghue & Horvath, 2016). This neuro process also includes the dimension of teacher work, which explains the teacher's actions to facilitate learning. On the one hand, it is important to understand the biology of learner abilities at the neurolevel because it can help teachers promote the learning process and development (Fischer, 2009). On the other hand, it should be acknowledged that teacher work, that is, teaching, just as learning, is not essentially only a dynamic mental process but also an even more complex sociocultural phenomenon (Donoghue & Horvath, 2016).

Information processing involves all cognitive processes: sensation, perception, memory, thinking, language, and imagination. Motivation and emotions are undoubtedly important drivers of cognitive processes. Based on these processes occurring in the learner's neurocognitive system, the most important aspects related to the neuroactivity of teaching have been identified (Table 1).

Table 1. Key neurocognitive processes and their relation to teacher activity
(Compiled by the Authors)

<i>Description of process</i>	<i>Methods applied by teachers</i>
Part 1. Process of excitation/arousal	
Various scientific experiences evoked and conveyed by the teacher must stimulate pupils' engagement in or excitement for the learning process.	Interesting scientific stories, different forms of humour, unexpected analogies, metaphors, movement, etc.
Part 2. Process of perception	
This process is the mental representation of the totality of an object, information, event, process or phenomenon by stimulating the sensory organs.	Questioning revision and/or explanation of more difficult topics, teaching methods that encourage pupils to relate new material to what they already know (illustrations, models, analogies, comparisons).
Part 3. Process of memorisation	
This process includes memorising, storing, and recalling information and/or actions.	Checking knowledge and skills differently (tests, questions, models, analogies, comparisons).
Part 4. The process of using, transferring and adapting information and/or actions	
It occurs when the teacher facilitates repetition/revision of the information or activity learnt. Teachers and pupils use various retrieval techniques because the processes of memorisation and retrieval are not identical in time or manner.	Recreating an image, picture or model through a narration; recreating a narration through a drawing, diagram, map, timeline, etc.

We consider it important to investigate whether teachers rely on neuroscientific knowledge in distance education. Thus, the object of this study is the chosen teacher's activity during online lessons. The study aims to clarify how teachers apply knowledge of neurocognitive processes in distance education.

Research Methodology

Sample

The lessons of different study subjects (Nature and Man, Geography, Biology, Mother Tongue (Lithuanian Language and Literature), Computer Science) delivered to 6th-10th formers in 3 schools in Lithuania were chosen to achieve the set aim. The total number of lessons was 28, and they were taught by 5 teachers

(women). The lessons were given as distant ones in May–June 2021 (in Teams/Zoom platforms). They were recorded and presented to the researchers in a digital form. The number of learners who attended the online lessons ranged from 3 to 13. Since the analysed lessons were taught in schools in Lithuania's northern and southern regions (rural areas), such a small number of learners is possible. Moreover, some lessons (e.g., Computer Science) were organised into subgroups, meaning 3 to 6 learners participated in these lessons.

Instruments and Procedures

The study used observation, combining qualitative and quantitative analysis methods. It is important because, on the one hand, the quantitative aspect of the study can provide a statistical descriptive analysis and allow an appropriate picture of the phenomenon under study. On the other hand, the qualitative aspect of the study is useful for seeking explanations that are often not provided by quantitative analysis alone (Hiebert & Grouws, 2007).

Data Analysis

The method of data analysis is content analysis. Two independent researchers performed the analysis according to the observation scheme. Each lesson recording was evaluated individually by each researcher, and then both researchers discussed their analyses and, if there were any discrepancies, re-analysed the lesson together. It should be noted that one of the researchers is an educational researcher, and the other is a neuropsychologist.

For all (28) observed lessons, the study results are presented in absolute numbers (in minutes of a lesson) at the four levels of neurocognitive processes. In addition to this quantitative analysis, an extended analysis of neurocognitive processes and related teacher training methods was also conducted.

Research Ethics

The research was approved by the Ethics Committee of the Education Academy of Vytautas Magnus University (Protocol number: SA-EK-21-03).

Results

First, the analysis of all 28 distance lessons revealed their diversity in terms of the components of the teaching process: a new theme was presented and analysed in almost half of them (13), the aim of 11 lessons was to master the subject-related knowledge and build skills, and 4 lessons were dedicated to consolidating the knowledge and skills learnt. Therefore, the lessons presented for the analysis were diverse and not of one type.

From a pedagogical point of view, the teachers managed the class properly, and an emotionally warm atmosphere prevailed during the lessons. At the beginning of most observed lessons, pupils were introduced to the objectives and success criteria of a given lesson, but not all lessons were summarised at the end regarding the achievement of the lesson objectives.

Part 1. Analysis of teacher activities based on the process of excitation/arousal. The observed lessons showed that the teachers quite actively rely on the first neurocognitive process (excitation/arousal). Active methods are often used in this process to encourage pupils' engagement. For example, a teacher of Lithuanian explains a new aspect of the study subject by using songs or chants and asking the pupils to come up with an extension.

The arousal process is necessary and usually occurs at the beginning of a lesson when attempts are made to evoke pupils' interest in the learning material. Table 2 (Part 1) shows the teaching methods used by the teachers during the first process and their duration in absolute (numerical) values for all the observed lessons.

It should also be noted that during the observed lessons, there were some inappropriate activities that the teachers used to excite their pupils. For example, during one of the lessons, the teacher asked pupils to take turns reading certain parts of the new material from the textbook but did not explain or comment on them or ask pupils to express their understanding/opinion. No active pupil engagement was observed during this activity.

Part 2. Analysis of teacher activity based on the process of perception. The teachers in the observed lessons also rely on the second neurocognitive process (perception). In this process, teachers usually use a verbal questioning approach to understand how much and what their pupils did and did not understand. During the observed lessons, pupils were asked questions from the subject textbook, visual material (presentations), or group work done by pupils. It should be mentioned that the questioning method is very important in distance learning because it activates the pupils and enables them to engage in meaningful participation in the lessons. Questions can be asked to the whole class or individually, but it is

important to see all the pupils and encourage them to participate, not just the volunteers. The conducted analysis allows claiming that most teachers applied this technique and did it very frequently: if an asked pupil could not answer an individual question, teachers invited other pupils to express their opinion (Table 2, Part 2).

During the observed lessons of different study subjects, pupils were not asked to structure or interpret new information to demonstrate their understanding in this neurocognitive learning process. It should be brought to the attention of teachers because the structuring of information, that is, the inclusion of new knowledge into the system of the already possessed knowledge, is of utmost importance in the stage of learning and acquisition.

Part 3. Analysis of teacher activity based on the process of memorisation. During the observed lessons, the teachers actively used methods related to the third neurocognitive process (memorisation Table 2, Part 3). All methods, which allow creating conditions for learners to revise the perceived information of a study subject in various ways and at different times, are important. This revision of perceived and memorised information occurs at the end of a lesson in which a new topic has been introduced and explored. Memorisation is often applied in the following lesson after introducing a new topic and aims to master knowledge and build skills.

The observed lessons allow concluding that teachers of different study subjects used oral or, more often, written methods to provide a targeted revision of certain aspects of complex learning material. For example, a quiz consisting of several questions in the Google environment was used in several lessons on Nature and Man, Biology, and Geography.

We would like to point out that in this third stage of the neurocognitive (memorisation) process, it is very important to test pupils' learned knowledge or specific emerging skills several times and at different times. Therefore, the ways teachers work, that is, revision, discussion of the topics of previous lessons, and self-study tests, identified during the observed lessons, are necessary and meaningful.

Part 4. Analysis of teacher activity based on using, transferring, and adapting information and/or actions. The learner's ability to use, transfer and adapt the information and/or actions of a particular study subject not only immediately (during the same or the following lesson) but also over a longer period after the introduction of a new topic and/or the consolidation of the lesson material (knowledge and skills) is considered a particularly valuable neurocognitive process, which is identified as the fourth one (Table 2, Part 4). During the observed lessons, teachers refer to it when asking pupils to answer or complete a particular

Table 2. Teaching methods applied by teachers in the four neurocognitive processes

Methods applied by teachers	Average duration (min.)	Minimum duration (min.)	Maximum duration (min.)	Number of lessons
Part 1. Process of excitation/arousal				
Demonstration of visual material	6.02	3.08	10.3	2
Verbal methods	6.40	3.31	10.3	2
Active methods	16.53	3.05	49.38	9
Games*	10.25	5.36	15.55	3
Part 2. Process of perception				
Verbal and visual methods to select/sort information	8.46	8.46	8.46	1
Verbal (questioning) method to check how pupils understood and what aspects of new information were understood best by pupils	19.41	5.03	42.13	15
Verbal and visual methods to relate a new topic to a life context relevant to a pupil	4.3	4.3	4.3	1
Verbal and visual methods to relate new information to previously known information	18.58	18.58	18.58	1
Part 3. Process of memorisation				
Verbal and written methods to verify learned information several times	8.32	2.53	13.16	3
Methods for targeted revision of difficult/complex material	10.3	4.28	16.18	7
More extensive testing of knowledge/skills through an independently conducted test	12.27	6.36	21.08	8
Part 4. The process of using, transferring, and adapting information and/or actions				
Verbal and visual methods for direct revision of learnt information	18.32	7.06	43.21	4
Verbal and visual methods for delayed revision of learnt information	30.12	4.03	44.1	4
Encouragement of pupils to explain in their own words**	19.25	5.33	42.7	5

*Games should also be assigned to active methods, but they are particularly liked and preferred by pupils (even by elder ones) and for this reason, the games were singled out as a separate activity.

**Distinguished separately because of significance

task, pointing out that the aspect of the subject now being asked about was taught a few weeks ago or that it is a separate aspect of a major topic or activity that has been taught over a long period (e.g., a month or longer). It is important to note that

information can be used immediately after completing a major topic (i.e., there is an immediate revision of information), or there can be delayed revision, where the information is asked to be used or generalised sometime after the learning itself.

It should be noted that, based on this neurocognitive process, encouragement to explain a term, a concept, a phenomenon, or an idea in own words is of utmost significance. We have singled this out as a separate method to emphasise its importance. We believe that teachers of various subjects should encourage pupils to generalise the information learned after some time in their own words (e.g., provide summaries, examples, explanations to a friend, etc.) or in visual ways (e.g., diagrams, pictures, algorithms, etc.) because it strengthens their understanding of the subject and their perception that they have learned something, as well as their self-esteem and their knowledge of “I can”, “I have learnt”, “I know”.

Discussion

The study investigating how teachers rely on neurocognitive processes in distance lessons reveals several important aspects.

Firstly, it must be admitted that this study is quite new, as no similar studies can be found on analysing the teacher's performance in distance education from a neuroscience perspective. Therefore, we hope this will serve as a foundation for further research, which is very meaningful and necessary.

Secondly, we dare to assume that the main processes that take place in the nervous system during learning do not depend on the teaching and learning method (contact or remote), the taught subject, or the age (only the duration of the process itself can differ due to the age of pupils). Therefore, every teacher should understand the presented and described neurocognitive processes and build their activities on them. For example, the methods designed to engage the pupil are crucial, as they are the first to excite/activate the pupil's brain activity during the lesson. It should be noted that the first principle of good memory is the focus of attention. Good memorisation can happen when we concentrate more on the material we hear, see, and want to learn or know. Therefore, how the teacher presents the learning material is important because it (the material) must stimulate the activity of the pupil's brain. According to researchers (McGinty et al., 2013), the brain only adapts and reacts proactively when faced with a new, different, or distinct situation.

The three stages of perception occur when appropriate methods are used to perceive educational material: selecting information (reference to attention again),

structuring information and understanding it (interpreting information). Again, it is important to concentrate when taking in new information, and one of the significant factors that contributes to concentration is the absence of stress or positive emotions. Namely positive emotions during learning increase pupils' attention and strengthen their memory (Li et al., 2020).

Finally, the third and fourth neurocognitive processes are related to the teacher's activities to reinforce the learning material and link it to the active and sustained use of the received information. By repeating, practising, that is, "working" with a specific material, pupils remember it better because they create and strengthen the neural connections that transmit such information. However, it is important to realise that consolidating learning material (knowledge and skills) requires different periods. The third stage is immediate and represents information recording into long-term memory. Its initial retrieval and the fourth neurocognitive process assesses the integration of learned information into the overall information field of knowledge accumulated by every pupil.

Thirdly, it is important to note that all four neurocognitive processes are strongly interrelated and intertwined. For this reason, the teacher's activities and the students' learning methods must be incorporated into different types of lessons. Similarly, pedagogical strategies for engaging the learner, comprehending or consolidating the learning material must not be limited to a single teaching or learning method. For almost a decade, research has been debunking the myth that the best learning and teaching is based on a particular learning style (Dekker et al., 2012). From the neurodidactic perspective, activating the whole brain (i.e., all sensory channels) is important. It means that whatever the type of lesson, the teacher must use various teaching and learning methods.

It is also necessary to discuss the limitations of this study. It is the first effort to analyse the neurodidactic process in distance learning. The study's sample size is small, so it is necessary to continue this research.

Conclusions and Guidelines for Further Research

The analysis of the observed lessons shows that teachers of different study subjects apply methods based on neurocognitive processes when teaching distance lessons. During excitation/arousal, active methods that promote involvement and excitation of pupils are applied most frequently. The perception process's verbal (questioning) method is used in more than half of the observed lessons. The processes of memorisation and using, transferring and adapting information and

(or) actions are related to the teacher's activities, which are aimed at consolidating the learning material and linking it to the active and sustained use of the information received. The teachers in the study have been found to employ various verbal methods and self-study tests to help pupils revise what they have learned or practice a particular skill under development, but they rarely use visual and practical methods. This study is the first step in examining the role of the teacher in distance learning from a neuroscience perspective. Therefore, further research is very useful and necessary.

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