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ELŻBIETA KOWALCZYK

Does digital eruption threaten teaching work at universities? The mental models of faculty for online teaching and learning

Abstract

Research background and purpose: From year to year, the digitalisation is more present in the work of faculty, but changing conditions raises many concerns and reluctant attitudes mirrored in MM. This leads to a sluggishness in using technology-based tools and persists in a nondigital condition.
The purpose of this paper is to diagnose mental models (MM) of university teachers with respect to online teaching and learning (OTL) and to show their impact on the professional performance of teachers. In the study, the author is seeking an answer on the title question - does digital eruption threaten teaching work at universities?
Design and methodology: In this study, MMs were measured using the Osgood semantic differential method, while occupational performance was measured on a 5-degree Likert-type scale.
Two cluster analysis methods were used and three types of MMs were distinguished among academics with regard to OTL: reluctant, neutral, and enthusiast. Furthermore, the dendrogram method was used to visualise the aggregation of statements related to OTL.
Findings: It was established that organisational technology support is not a differentiating factor for teachers' MMs. An enthusiast MM was found to result in lower stress related to OTL, greater self-esteem in digital competence, and a desire for self-improvement. Better assessment of students' abilities and student motivation and relationships. The use of technology-based educational methods depended on the type of MM.
Value added and limitations: The research contributes to the discussion on the need for change in the attitudes of academics towards the use of online tools in teaching and highlights the mismatch between teaching tools and the expectations of society 5.0. The main limitation of the research is the number of respondents and the spatial coverage of the research. The difficulty also stems from the boundaries of the tools that are used to measure mental models.

Keywords: *online teaching, online learning, mental models, digital acceleration, higher education*

JEL Classification: I2, M5

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Elżbieta Kowalczyk ✉
Institute of Management, UE Poznań, Poland, UE Poznań, Al. Niepodległości 10, 61-875, Poznań, Poland; email: e.kowalczyk@ue.poznan.pl
ORCID: 0000-0003-4611-2246

1. Introduction

1.1. Mental models

Doyle and Ford (1998) noticed that although the concept of 'mental models' frequently appears in the literature, there are surprisingly few explicit definitions of them. However, mental models are relatively often defined as mental constructs describing the knowledge a person has about a particular domain of the world. On the one hand, they represent the operation of cognitive processes, but, on the other, they are also a result of these processes (Hemforth & Konieczny, 2006). They show how the world is constructed and the relationships that occur in it. Mental models represent an asymmetric relationship between a person and an object (concrete or abstract). They are characterised by subjectivity, they arise from the experiences of the individual, but they also affect people's experiences and behaviour (Pauen, 2006). It is assumed that the more often an event is repeated, the more likely it is to be perceived as typical and standard, thus becoming the basis for the construction of a model representation of a given problem, process, or phenomenon. At the same time, models include not only the object itself, but all the phenomena related to it; they create certain expectations about them (St.Amant, 2021). Many people create mental models without direct experiences but through information acquired indirectly and treat them as instructions or guidelines for dealing with various situations, also those that are new to them (van Ments & Treur, 2021). To understand and then improve selected processes based on mental models, they must be accurately identified and described, and the way in which they influence the behaviour of the main actors must be analysed. Although they are a subjective reflection of the world, they are also shared by people belonging to the same teams, groups (e.g. medical staff, teachers, managers), or cultures (organisational or national). Models do not have to physically reflect an object, but should depict how it works. Teachers' mental models can be formed or influenced by various factors, and the six factors are: teachers' explanations, textbooks, language, and words, daily experiences, social environments, causal, and intuitional relationships (Chiu & Lin, 2005).

Mental models are used to describe the perception of abstract concepts, as well as the accompanying beliefs and ideas, in areas such as learning challenges, leadership, or interpersonal communication. They can be used to identify areas that generate problems or improve performance and determine methods to improve them. Mental models can be used by researchers and practitioners in many disciplines where it is crucial to know how people think, make decisions, and act in particular areas of their microactivity (Jones et al., 2011).

According to Senge, teachers' MMs could be understood as deeply rooted assumptions and generalisations that influence how teachers understand the world,

that is, how their educational organisation is organised and how to act (Tarnanen et al., 2021). Mental models help teachers recognise the reality in which they operate and the changes that are taking place. They facilitate self-management and performance in their professional role (Manrique & Abchi, 2015). It is shown that teachers' mental models are the result of learning practices rather than depth of content knowledge. Furthermore, even when teachers' knowledge of the subject deepens, they do not transform teaching practices until they develop their mental models (Tarnanen et al., 2021).

We can distinguish between two types of teachers' mental models: in-action, based on teacher-student interaction, and on-action, when they talk about their experience. Research found that changes in teacher job performance must be preceded by a change in their mental model and that this is shaped mainly by practice (Russo-Zimet, 2017). Therefore, positive experiences are important, for example, during training in a safe environment with the support of a competent person, as this allows for a change in the general mental model and a subsequent change in the way teachers work.

Unfortunately, insufficiently developed research methodology with regard to mental models is one of the main challenges that hinders reliable scientific analysis and sometimes leads to abandonment of research in this matter. They can be diagnosed by means of a range of, often non-standardised, methods (Klein & Hoffman, 2008; Merry et al., 2021). The material obtained from some of these methods can be ambiguous to interpret and requires qualitative analysis, making quantitative research difficult. Another occasionally used method is semantic differential (e.g. Scherpereel, 2005), which has the advantage of obtaining material that is relatively easy to analyse statistically.

1.2. Online teaching and learning in higher education

In recent decades, digital literacy has enabled educators to fulfil their professional roles in a way that is adjusted to the changing globalised environment, in which we have experienced and are experiencing rapid advances in technology and the development of the information society (Antonietti et al., 2022). With these changes, the need for digital-competing teachers has evolved, revealing the need for new approaches in the integration of technology into education, requiring a new set of skills, knowledge, and attitudes, in addition to literacy with the change in new technologies (Gündüzalp, 2021). But according to the OECD average score form survey conducted in 2018 only 43% of teachers felt well or very well prepared to use ICT for teaching (OECD, 2019). Furthermore, in the European Union, it is very important to encourage educators to acquire digital meta-skills that mediate their relationship with learners (Caena and Redecker, 2019; Toto and Limone, 2021). For

a better adaptation of every individual to digital reality, the European Commission has introduced a new Digital Education Action Plan, which calls for greater efforts to strengthen digital skills and capabilities to support digital transformation in education (European Commission., 2022).

At the beginning of the second decade of this century, mainly due to the COVID-19 pandemic, we observed the digital acceleration in education in most countries (Guppy et al., 123 C.E.; Watermeyer et al., 2021), including Poland. The process of replacing traditional methods often raises doubt, and many teachers oppose them. The sudden and forced situation was a source of negative emotions experienced by teachers, which resulted in many of them leaving the profession, especially at the beginning of their teaching career (Pressley et al., 2021). As a result of the new reality, a variety of methods for student activation were introduced; for example, quizzes were used four times more frequently than before, and materials (presentations, videos) were prepared more frequently and made available on the teachers' websites and blogs. On the other hand, the number of teachers who dictate notes and show ready-made educational videos decreased. A major challenge for many teachers was verifying students' knowledge. For example, in order to reduce cheating when writing tests, navigation between questions was disabled, and the time allowed for answering the questions was very short (Pyżalski & Walter, 2021).

In turn, EU statistics (Table 1) show the use of ICT for educational purposes by students in selected countries. During the period of enforced acceleration, the leap in terms of the use of online learning in relation to the level of 2019, regarded as a benchmark, was very large in Poland; and, unfortunately, so was the decline after the forced OTL period was relaxed (Figure 1). The use of the Internet in education was a compulsion and, as such, was eagerly abandoned when the restrictions were lifted. Fatigue, insufficient technological support, and the prevalence of unattractive teaching methods (Table 3), causing a negative balance of benefits and losses from online learning (Nayak et al., 2022), meant that Poland was unable to maintain a good level in terms of online learning. This reduced the chances of digital transformation of public universities in Poland, and competitive higher education institutions increased their advantage over them. Additionally, the reluctance to use OTL makes it difficult to introduce blended learning forms, which is considered to be leading in post-pandemic teaching (Zhu et al., 2022).

Table 1. **Internet use: doing an online course (of any subject) or using online learning material**

Selected European Countries	2017	2019	2020	2021	2022
European Union – 27 countries (from 2020)	45.85	50.74	69	76.47	63.65
Euro area	47.65	53.16	69.41	76.64	66.49
Czechia	50.98	43.93	67.87	82.29	60.06
Denmark	29.33	49.25	70.19	58.06	62.04
Poland	29.85	34.57	74.5	79.56	40
Finland	88.16	90.27	95.33	98.1	92.6
Sweden	76.72	77.37	80.89	94.01	85.3
Slovakia	39.82	45.48	71.89	74.58	69.59

Source: Eurostat, n.d.

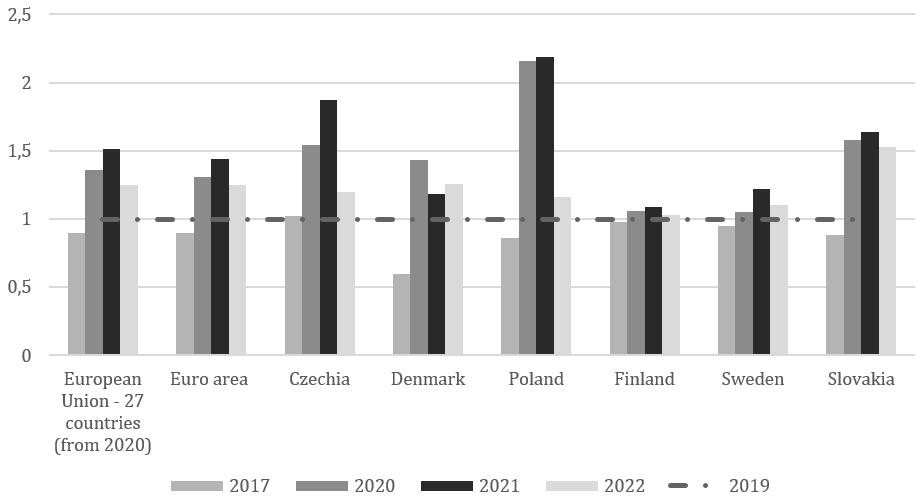

Figure 1. **Dynamics of Change in Student Use of the Internet to Do Online Courses in Select EU Countries**

Note: 2019 in each country was assigned the value of 1.

Source: calculated on the basis of Eurostat, n.d.

Measures must be taken to encourage teachers to incorporate digital competence into the education process (Karageorgou, 2022). Teachers can improve their levels of digital competence through training, especially in the field of educational technology. This training must be practical and experimental in nature and give them self-confidence in using digital technology (Dias-Trindade & Moreira, 2020). Teachers should be able to navigate digitally, communicate, and collaborate with their students and colleagues. In addition to navigation, interaction, and collaboration are two essential skills for educators / learners of the 21st century (Darwanto et al., 2021).

Although this requires special teaching methods adapted to the digital environment, some of the teaching methods used in online classes are copies of those previously used and familiar to teachers from on-site classes. Others take a more creative approach to the new conditions and adapt their methods to virtual reality. There are also those who gradually, in small steps, improved their teaching repertoire (Pyżalski & Walter, 2021). The best job performance requires a combination of learner-centred approaches, teaching and learning methods, and methods for assessing learning outcomes (Gurley, 2018). However, in many cases, it was only sudden and unpredictable reality that became the catalyst forcing them to step out of their comfort zone and acquire new competencies in online teaching (Li & Yu, 2022; Watermeyer et al., 2021). For effective teaching and training, teachers must have adequate knowledge of technology, but institutions must also have the ability and availability of technology infrastructure such as computers and computer laboratories (Rahman, 2020). Several studies have found that the readiness to teach online is also influenced by seniority. Teachers with higher seniority were found to be perceived as more ready to teach online than teachers with a shorter teaching experience (Undar & Madrigal, 2021).

It should also be noted that the performance of teachers in the online environment was influenced by the level of anxiety and digital stress of teachers. Digital stress is believed to play a key role in explaining the relationship between the use of digital tools and performance. Types of digital stress include availability stress, approval anxiety, fear of missing out, and connection overload. These result in feeling depressed and experiencing difficulty in fulfilling social roles; however, appropriate coping methods can improve a person's digital performance (Hall et al., 2021). Anxiety about online teaching has a significant impact on teaching effectiveness, because the incidence of technical problems in the context of online teaching is higher than in face-to-face teaching, and teachers are not sufficiently skilled in the use of certain online teaching devices or platforms (Zhang et al., 2022).

The following research hypotheses were formulated:

Hypothesis 1: There are different types of mental model of academics with respect to online teaching and learning.

Hypothesis 2: Differences in teacher professional performance are related to their type of online mental teaching and learning.

2. Research methods and Procedures

To diagnose mental models, empirical studies used Osgood's semantic differential (Heise, 1969; Osgood, 1964), whose bipolar scales examined the semantic connotations associated with online teaching. The Osgood technique method is a psychometric technique created in early 1950. and based on standardised scales which can be used to measure a lot of ideas, attitudes, and concepts. The empirical studies conducting around the world show this method as reliable, objective and valid. In this method very impotent is to choose the topic and adjectives describing it (Rosenberg & Navarro, 2018). The semantic differential used by the author of this paper is now widely used in social sciences such as psychology, sociology, management, marketing, and even in information system analysis or machine design (Stoklasa et al., 2019). This method is one of the most suitable for investigating the connotative meanings of complex problems and multidimensional structures (Berlyne & Peckham, 1966; Verhagen et al., 2015). Given all the above, the author concluded that it can be used to describe mental models. Furthermore, its results are more unambiguous in interpretation than metaphor analysis and make it possible to study a larger sample than methods based on interviews or diagram analysis. According to the semantic differential methodology, respondents were asked to rate their attitudes toward online teaching on eight seven-point scales. The disadvantage of this method is the inability to diagnose whether the model under study is based on an on-action or in-action approach. Due to the time span of the study, it can be assumed that some respondents reported on the practice model, while others reported on the practice model. The reliability of the constructed scales was evaluated using Cronbach's alpha and was greater than 0.72.

The second part of the questionnaire contained 10 statements to which the participants responded using a five-point Likert scale. Their purpose was to measure the professional performance of academic staff in the area of online teaching. The reliability of the method was assessed using the standardised Cronbach alpha coefficient, which was 0.753. Removing two of the statements would have resulted in an increase in reliability, but due to its content and the new context of the study, the decision was made to leave them in the pool for further analysis. Furthermore, the small number of statements and their diversity make the lower coefficient values acceptable (Bedyńska & Cypryańska, 2013). The third part of the questionnaire evaluated the use of teaching methods in online education. A self-assessment method was used in both parts of study.

The purpose of the research was to diagnose the mental models of university teachers with regard to online teaching and learning (OTL) and to show their impact on the professional performance of teachers.

In the study the several questions were formulated: are we experiencing a digital eruption in higher education? Is the energy of the proponents of digitisation in teaching

being put to good use? Are we moving towards a redesign of education for the 21st century and society 5.0, or are we rather condemned to obstructionism sustaining didactic conservatism?

The 606 respondents surveyed were university teaching staff. Email, intranets, and the LinkedIn social networking site were used to reach the respondents. A link to the Google form was distributed among academic teachers from Polish universities, mainly public ones (90,6%). These institutions were located in the western part of Poland. The surveys were anonymous and voluntary. The group consisted of 317 (52,3%) women and 289 men (47,7%), the age of the respondents was M= 43,6 (SD = 9.94). 15% of them had a master's degree, 43% a doctoral degree, and the rest had at least a postdoctoral degree. Purposive selection was used in the research. Respondents were required to teach in higher education institutions.

3. Results

3.1. Types of Mental Models

To diagnose the respondents in terms of differences in their perception of OTL, a log-likelihood distance test method was used, performed using a two-step cluster analysis with eight dimensions as variables. The Silhouette measure of cohesion and separation indicated correct clustering (average Silhouette value = 0.3)

The analysis led to the distinction of three models. The percentage distribution of the respondents within the groups is illustrated in Figure 2. Table 2 presents the validity of the predictors used to distinguish the three types of models. The most important predictor was the depletion-enrichment dimension, while the least significant predictor for distinguishing the clusters turned out to be the independence-teamwork dimension.

Table 2. **The Validity of Bipolar Predictors in Two-Step Cluster Analysis**

Dimensions	Validity
Depletion - Enrichment	1.00
Barriers - Opportunities	0.91
Temporariness - Permanence	0.66
Hinders learning – Supports learning	0.65
Unpleasantness – Pleasure	0.63
Necessity – Freedom of choice	0.44
No emotion – A lot of emotion	0.29
Independence – Teamwork	0.07

Source: own study

3.2. Characteristics of mental models

Figure 2 shows the medians of the dimensions analysed for each mental model. Those who represented the reluctant model obtained the lowest values for all the dimensions that describe the model. In the enthusiast model, the respondents obtained the highest scores; and in the neutral model, the mean values. Only for the dimension 'no emotion - lots of emotion' was the median for the neutral and enthusiast models the same (with the difference between the models being statistically significant $p < 0.001$).

To determine the nature of the differences between the models, a Kruskal-Wallis H-test analysis was performed. The Dunn test with Bonferroni significance level correction was used as *post hoc* analysis. For all dimensions, the analysis showed statistically significant differences between the models; The dimensions values were lowest in the reluctant model, moderate in the neutral model, and highest in the enthusiast model ($p \leq 0.005$). Therefore, Hypotheses 1 was positively verified. The results are presented in Table 3.

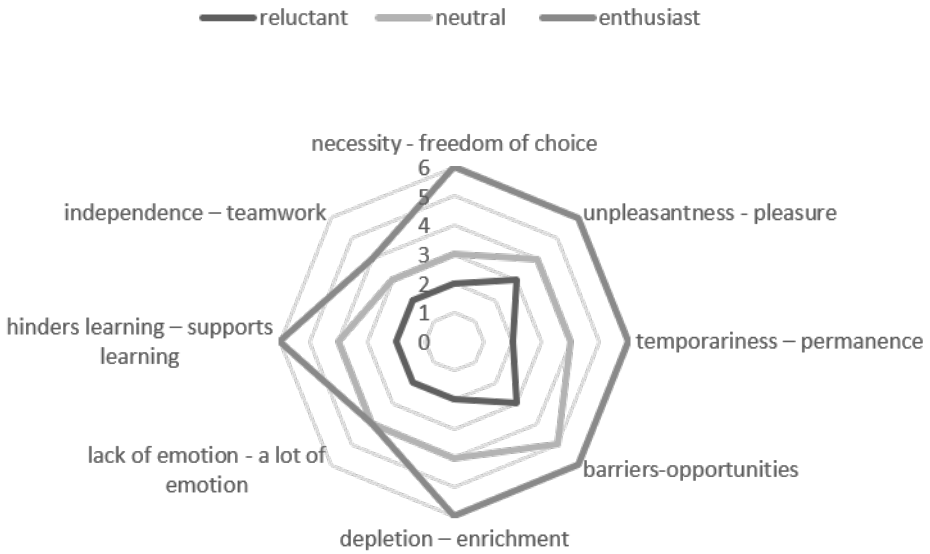

Figure 2. **Medians of the dimensions of the individual OTL models**

Source: own study

Table 3. **Comparison of OTL models in terms of dimension**

Dimensions	Mental Models	N	Average rank	Me	IQR	H	p	η^2
Necessity – Freedom of choice	reluctant	194	190.12	2	2	208.00	<0.001	0.34
	neutral	278	302.42	3	2			
	enthusiast	134	469.88	6	2			
Unpleasantness – Pleasure	reluctant	194	161.04	3	2	292.94	<0.001	0.48
	neutral	278	315.56	4	1			
	enthusiast	134	484.74	6	1			
Temporariness - Permanence	reluctant	194	156.57	2	1.25	291.37	<0.001	0.48
	neutral	278	318.50	4	2			
	enthusiast	134	485.11	6	1			
Barriers – Opportunities	reluctant	194	133.74	3	2	369.26	<0.001	0.61
	neutral	278	326.81	5	1			
	enthusiast	134	500.90	6	1			
Depletion and enrichment	reluctant	194	129.99	2	2	384.02	<0.001	0.63
	neutral	278	327.50	4	2			
	enthusiast	134	504.91	6	2			
No emotion – A lot of emotion	reluctant	194	180.18	2	2	162.08	<0.001	0.27
	neutral	278	339.05	4	1			
	enthusiast	134	408.27	4	1			
Hinders learning – Supports learning	reluctant	194	147.70	2	1	292.50	<0.001	0.48
	neutral	278	332.17	4	2			
	enthusiast	134	469.58	6	1			
Independence – Teamwork	reluctant	194	245.34	2	2	43.21	<0.001	0.07
	neutral	278	312.45	3	2			
	enthusiast	134	369.13	4	2			

Source: own study

3.3. Differences in professional performance of university teachers and their mental models

To compare the individual mental models of OTL in terms of the professional performance of university teachers; based on the responses to the ten statements on a five-point Likert scale; an analysis was performed using the Kruskal-Wallis H test. The significance of the differences between the models was confirmed by *post hoc* analysis using the Dunn test with Bonferroni's significance level correction. To obtain a picture of professional performance, the statements were also subjected to an agglomeration analysis based on Euclidean distances and the Ward method (Figure 3).

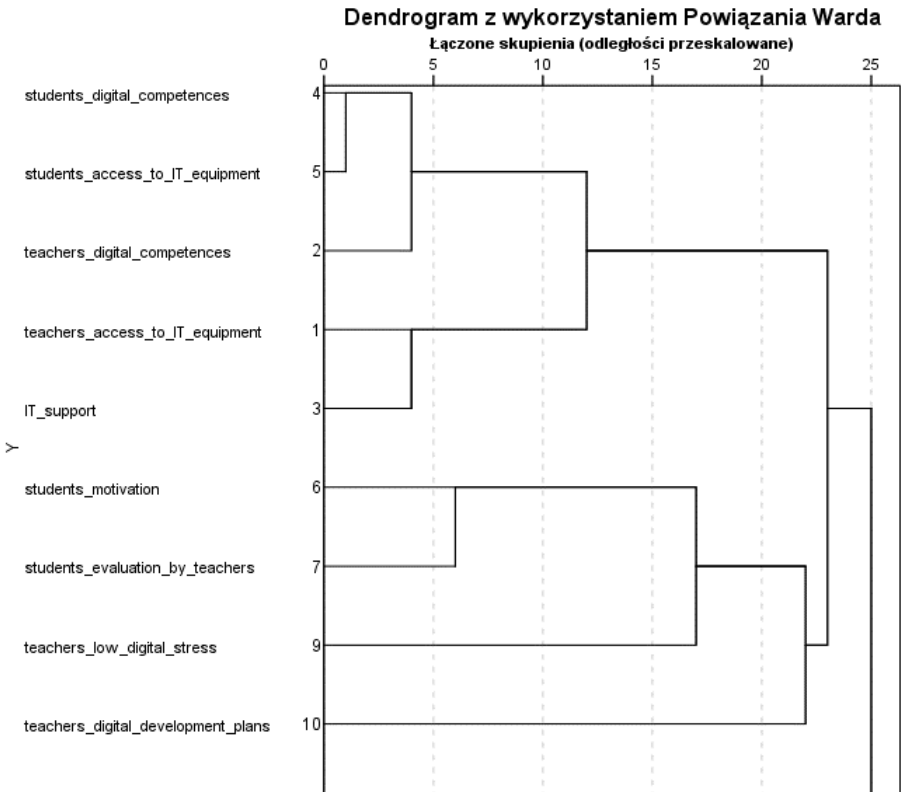

Figure 3. **Visualisation of the aggregation of statements in an OTL mind map**

Source: own study

The generated diagram shows that there are two main clusters of statements related to academic professional performance in terms of OTL: digital resources and digital processes. In addition, the teachers prepared audiovisual materials. Detailed results are presented in Table 4.

The first set focusses on organisational resources, described by two statements related to the institution of higher education. Interestingly, the analysis did not reveal any differences in the perception of organisational activities between the three mental models.

The following two statements related to digital resources were grouped together in a group related to digital competences and availability of IT equipment among students (student resources), as well as the self-assessment of teachers of digital competences (together these can be considered teaching resources).

Teachers representing the reluctant mental model gave significantly lower ratings on the ownership of students' IT equipment that allowed them to participate in online activities (compared to those representing the enthusiast ($p < 0.001$) and neutral ($p = 0.023$) models), and the digital competence that allowed students to participate in online activities (in enthusiast MM ($p = 0.010$)); as well as their own digital competence for online teaching compared to those of the other two models (neutrals $p = 0.005$ and enthusiast $p < 0.001$).

In terms of the *digital teaching process,* questions related to student motivation and teacher knowledge in terms of assessing student progress online were agglomerated. This factor can be called the *teaching relationship* and is related to two other issues called *digital stress and development*: lower digital stress, as well as teachers' plans for developing their competencies.

Within the *teaching relationship,* the evaluation of teachers representing the reluctant model was significantly lower in terms of the motivation of students to participate in online activities (in comparison to those representing the enthusiast ($p < 0.001$) and neutral ($p < 0.001$) models); and progressively higher in subsequent models ($p \leq 0.016$) in terms of their own knowledge of how to evaluate the progress of students in online learning.

The digital process also includes the level of stress associated with online teaching, which was highest in those with the reluctant mental model (relative to neutral MM ($p = 0.001$) and enthusiast MM ($p < 0.001$)), and at the same time it was higher in those representing the middle model relative to teachers with the enthusiast model ($p = 0.002$), who experienced it the least. Furthermore, plans to increase their digital competence in the field of online teaching in those who represented the reluctant mental model were significantly less evident than those who represented the neutral model ($p = 0.008$) and the enthusiast model ($p = 0.029$) model. Teachers representing reluctant MMs have poorer quality *digital resources* and *digital teaching processes;* they experienced *digital stress more strongly.*

Table 4. **Comparison of OTL models in terms of evaluating the performance of university teachers**

Professional performance of university teachers with regard to online teaching						Mental Models	N	Average rank	Me	IQR	H	p	η^2
MARGINAL DIMENSION – Digital content creation,	DIGITAL RESOURCES	Organisational Resources		My institution has the IT infrastructure necessary to conduct online classes.		reluctant	194	290.74	4	1	1.75	0.418	0.00
						neutral	278	308.69	4	1			
						enthusiast	134	311.21	4	1			
				I can count on the support of my institution with regard to online teaching.		reluctant.	194	297.08	4	1	0.43	0.807	0.00
						neutral	278	307.03	4	1			
						enthusiast	134	305.48	4	1			
		Teaching Resources	Students' digital resources for students	My students are digitally competent to participate in online classes.		reluctant	194	279.81	4	1	8.68	0.013	0.01
						neutral	278	305.79	4	1			
						enthusiast	134	333.05	4	1			
				My students have IT equipment that allows them to take part in online classes.		reluctant	194	270.14	4	1	19.01	<0.001	0.03
						neutral	278	304.29	4	1			
						enthusiast	134	350.16	4	1.25			
		I am digitally competent to teach online.				reluctant	194	263.20	4	1	22.11	<0.001	0.03
						neutral	278	310.96	4	1			
						enthusiast	134	346.36	4	1			
	DIGITAL PROCESSES	Digital development plans	Digital Stress	Teaching Relationships	My students are motivated to participate in online classes.	reluctant	194	234.02	3	1	56.60	<0.001	0.09
						neutral	278	323.98	3	1			
						enthusiast	134	361.62	3	1			
					I know how to assess students' progress in on-line teaching.	reluctant	194	245.01	3	2	44.08	<0.001	0.07
						neutral	278	315.43	4	1			
						enthusiast	134	363.43	4	1			
				Online teaching is very stressful for me.		reluctant	194	354.98	3	2	38.39	<0.001	0.06
						neutral	278	299.21	2	1			
						enthusiast	134	237.88	2	2			
		I am planning to improve my digital competence in the field of online teaching.				reluctant	194	272.05	4	1	10.70	0.005	0.00
						neutral	278	317.79	4	1			
						enthusiast	134	319.37	4	1			
I have prepared lectures/presentations in audio-visual form.						reluctant	194	288.54	4	2	2.59	0.274	0.01
						neutral	278	307.30	4	3			
						enthusiast	134	317.27	4	3			
Number of methods used						reluctant.	194	255.64	3	2	28.92	<0.001	0.04
						neutral	278	311.14	3	1			
						enthusiast	134	356.94	4	2			

Source: own study

These categories were aggregated with the overarching factor of creating digital content in the form of audiovisual material, and there were no statistically significant differences in these issues between teachers representing different mental models.

Additionally, the number of teaching methods used by teachers in their online work was examined. Those with a reluctant MM used the smallest number, while those with an enthusiast MM ($p \leq 0.032$) used the most. The methods listed in Table 5 differ in the extent to which ICT tools are used. They range from simple solutions limiting the interaction between teacher and students (e.g. sharing of materials, online lectures) to communicators based on asynchronous and synchronous communication between teacher and students (e.g. mailing, chats, zoom). The most advanced methods aimed at involving students in the learning process (e.g., games or project development). Teachers and students can use different ICT tools (e.g. AI, chatbots, etc.) depending on their digital skills, working approach, or didactic method. Furthermore, the relationship between MM and the use of specific online teaching methods was analysed using the χ^2 test of independence. Analysis showed that individuals with reluctant MM were less likely than those in the other two groups to provide files for students with materials for independent work, to hold discussions with students via on-line communication tools, or to use interactive games that engaged students. Respondents who represent this model also less frequently worked on creating online projects with groups, less often conducted chat rooms, and more often declared that their classes could not be conducted online than enthusiast types. Detailed results are presented in Table 5 (changes between studies are indexed by *a* and *b*). Taking into account the factors mentioned above, it can be concluded that *Hypothesis 2* was positively verified.

Table 5. Frequency analysis with ² test of independence for the relationship between cluster membership and frequency of online teaching methods used

Teaching methods	Mental Models						χ^2	*p*	*V*
	Reluctant		Neutral		Enthusiast				
	n	%	*n*	%	*n*	%			
Online lectures	156	80.4	229	82.4	112	83.6	0.58	0.746	0.03
Providing files with materials for students' independent work	152_a	78.4	246_b	88.5	126_b	94.0	18.44	<0.001	0.17

Holding discussions with students via on-line communicators, e.g. Skype, MS Teams, Zoom.	118_{a}	60.8	205_{b}	73.7	105_{b}	78.4	14.15	0.001	0.15
Working with the group to create an online project	45_{a}	23.2	$71_{a,b}$	25.5	47_{b}	35.1	6.17	0.046	0.10
Using interactive games to engage students	9_{a}	4.6	42_{b}	15.1	26_{b}	19.4	18.25	<0.001	0.17
Conducting chats with students.	87_{a}	44.8	$141_{a,b}$	50.7	84_{b}	62.7	10.22	0.006	0.13
My classes cannot be conducted online.	20_{a}	10.3	$16_{a,b}$	5.8	3_{b}	2.2	8.97	0.011	0.12

Values in columns that do not share a letter index differ at the $p < 0.05$ level (Bonferroni correction)

Source: own study

4. Discussion of the Results

Summarising the results obtained, it can be observed that in terms of digital organisational resources, a phenomenon the author labelled *organisational nihilism* occurred in which the university's support for OTL did not affect the MM of the respondents. The study found that the respondents did not incorporate the support of the institution into their mental models. This phenomenon can be explained by factors related to the concept of *Perceived Organizational Support* (POS). According to POS, efforts made by an organisation to improve working conditions should have a positive impact on satisfaction and attitudes towards work. POS, based on social exchange theory, assumes that employees feel supported when they believe that the organisation values them and their work, and at the same time cares about their career development and wellbeing (Kurtessis et al., 2015). Meta-analytical studies show that the perception of organisational support is adversely affected by factors such as the size of the organisation and being part of the educational sector (both of which apply to universities). In addition to the aforementioned job conditions, antecedents in the POS concept also include fairness, supervisor support, and organisational rewards (Ramadhani, 2020; Rhoades & Eisenberger, 2002). Therefore, more research should be carried out in the higher education sector evaluating the constellation of POS inhibitors that, despite evident efforts on the part of the organisation, prevent the

emergence of expected effects in terms of increased satisfaction and positive attitudes towards online teaching. Especially since achieving a competitive advantage by universities is possible thanks to a coherent strategy of using ICT and AI (Fernández et al., 2023; Hashim et al., 2022), which will be accepted, perceived as valuable and implemented by teachers and students.

In terms of digital learning resources, a correlation was found between the assessment of digital resources of students and teachers' digital competency to teach online. A low assessment of one's own competence leads to a lower assessment of student resources and is characteristic of reluctant MMs, while the other MMs are characterised by a more positive perception of their own resources and of students. As a result of digital acceleration, the number of people reluctant toward online teaching grew, and the numbers of enthusiasts declined. Consequently, more people were underperforming and fewer were performing very well in their jobs.

Attention must also be paid to the relational nature of teaching, the factors that affect student motivation, and the role of teachers' competences in evaluating student progress. Student attitudes depend on the behaviour, professionalism and commitment of teachers and the support they provide to students. Research conducted during the pandemic suggests that student motivation is a mediating variable between teaching methods and students' achievements. Technological infrastructure, in contrast, does not affect student motivation (Novilia and Riyanto, 2023). In the study of the author, access to the infrastructure was not related to student motivation. The correlation between the motivation of students for online learning and the ability of teachers to evaluate student progress can be explained by the dominating role of extrinsic motivation, according to teachers surveyed. However, research in this area suggests that this type of motivation is correlated with intellectual and academic engagement with the goal of completing a task rather than acquiring new knowledge, while intrinsic motivation leads to increased knowledge, proficiency, and satisfaction with learning (Ferrer et al., 2020).. Additionally, the motivation of students to learn online is influenced by the attractiveness of classes, a friendly environment, and their personal characteristics. Therefore, it is not so much the evaluation of progress that plays a key role in sequencing, pacing, and access to learner support (Kim & Frick, 2011). Positive students' emotions (Zhu et al., 2022) and teachers' competence in terms of online learning prove to be crucial to student motivation (T. K. F. Chiu et al., 2021). Furthermore, activities that engage students through skilful online communication, task interactivity, and social context lead to student satisfaction and better academic results (Ming Wut et al., 2023).

The pedagogical use of technology requires a complex model called Knowledge of Technological Pedagogical Content Knowledge (TPCK). In this model there are three components: technological knowledge, pedagogical knowledge, and content knowledge. Teachers can use ICT in education when they have all these types of

knowledge (Mishra & Koehler, 2006). It is necessary to replace old knowledge systems. Teachers with enthusiastic MM will be more motivated to do this work than those with reluctant MM.

5. Conclusions

The author achieved the aim of the study, which was to diagnose the mental models of university teachers with regard to online teaching and learning (OTL) and to show their impact on the professional performance of teachers. Both hypotheses formulated were positively verified. In the study, we establish that there are three types of mental model of academics with respect to online teaching and learning (hypothesis 1). And secondly, the differences in teacher professional performance are related to their type of online mental teaching and learning (hypothesis 2).

Digital acceleration and the necessity of remote work have made many people aware of the deficiencies in their digital preparation. A digital effect (Figure 4) is created by the spread of energy from the deeply located centre towards the outer layers, acting as a blockade for the generated energy. The epicentre of change are teachers with enthusiastic MM, but there are only 22% of them. So, is this enough to generate a force that changes the old approach and traditional philosophy of didactics? The

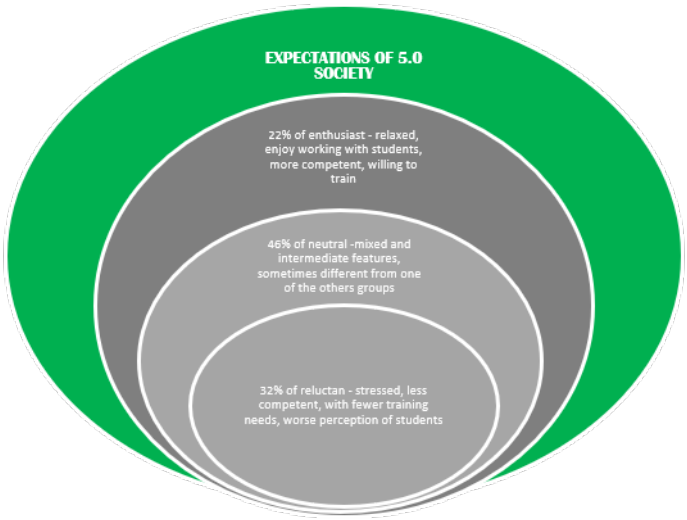

Figure 4. A digital eruption effect of mental models

Source: own study

energy generated passes through 46% of the barriers created by teachers with a neutral MM, losing momentum in the resistance put up by those reluctant to OTL, of whom there are 32%. So, we are not experiencing a jet-a digital eruption in higher education. And the energy of enthusiastic teachers is effectively blocked. In the author's opinion, we should move towards a redesign of education for the 21st century and society 5.0, and make a greater effort against the obstructionism that perpetuates didactic conservatism.

In order to increase the number of teachers using an enthusiast mental model, employers could elaborate complex, inclusive different groups of university teachers (e.g., gender, age, course subject) attractive programmes for developing digital competence. The propositions related to the knowledge and skills needed to prepare, promote, and implement digital teaching methods will be very valuable. Within university departments or institutes, it will be very useful to establish local support groups made up of people with different levels of digital proficiency. However, the problem is deeper, and therefore, first of all, it requires an overhaul of the strategic management of higher education institution, its personnel strategy and then of the higher education system. In a new approach, teaching based on extrinsic motivation should be limited. It requires the development of intrinsic motivation for online learning among teachers and students at all levels of education. Taking into account the facts and reflections mentioned above, digital eruption does not threaten teaching work in universities.

The experience of the digital eruption in education is not related to a lack of tools, but to teachers' inadequate use of them. Developers are working on new functions to make them more attractive. The problem is related to motivation and the frequent approach to didactics as a duty for which academic teachers in Poland do not feel responsible. The main task of higher education managers is to introduce requirements for continuous improvement of competencies and to make the educational offer more attractive. To make it compatible with the requirements of Society 5.0.

The main limitation of the research is the number of respondents and the spatial coverage of the research. The difficulty also stems from the boundaries of the tools that are used to measure mental models. Their main weakness stems from the impossibility of verifying the validity of the measurement by referring to other psychometrically validated tools.

Further lines of research on teacher mental models can include, among others, monitoring changes in university teacher mental models, developing reliable and standardised methods to measure mental models, or researching the causes and consequences of organisational nihilism in a higher education environment.

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