Research on the Types of Future Teachers' Self-Realisation Under Conditions of a Digital Educational Environment

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ABSTRACT

Aim. Empirical research and theoretical substantiation of the types of self-realisation of future teachers who did an educational-professional training course under conditions of a digital educational environment. Investigating the types of self-realisation and establishing statistically significant correlations with the research parameters of educational-professional training for future teachers will allow finding important scientific facts that will possess novelty and be of scientific interest for organisers of educational and scientific activities in a digital educational environment.

Methods. The representative sample involved students of the final years of pedagogical educational programmes of Bachelor's and Master's studies. Methodological foundations of the research are the main statements of the concepts of self-realisation, self-actualisation and self-regulation in educational activity.

Results. Spearman (r_s) correlation coefficient allowed us to find that "value orientations", "time competence", "cognitive needs" and "creativity of activity" are the most important and dependent parameters. k-means clustering allowed identifying four types of self-realisation: "Value-oriented self-realisation"; "Temporal self-realisation"; "Passive self-realisation" and "Pragmatic self-realisation". It explained that high external negative motivation in the type of passive self-realisation is not directly related to the process and results of educational-professional activity, but only reflects future teachers' attitude towards it. It was highlighted that future teachers with a value-oriented type of self-realisation are ready to devote themselves to pedagogical activity and consider it to be the meaning of their life.

Conclusion. It was recommended that the established empirical facts possessing cognitive value, scientific and theoretical novelty should be implemented in creation and improvement of a digital educational environment.

Keywords: self-regulation of an individual, educational space, inclusive educational environment, professional training, time competence, university, distance learning

Introduction

Rapid changes occurring in our society, pandemics, war conflicts and natural disasters actualise the issues of high-quality professional training for future teachers. Social, economic and political reality encourages search for optimal methods for efficient delivery of educational and scientific services. The lockdown caused by the COVID-19 pandemic and the martial law in Ukraine created conditions for introducing distance education and searching for the ways to deal with the current critical situation (Kobylarek, Alaverdov et al., 2021; Suchikova et al., 2023). Dynamic development of artificial intelligence also directs the vector of training future professionals towards a digital educational environment. A digital educational environment is a constructed reality in which a contemporary society exists. High-quality educational-professional training for any professionals in the field of socionomics is the interaction "human–human" which requires formation of a number of competences in teachers. Reflective and empathic competences are the key ones ensuring efficient work with people. A rapid shift of delivery of educational services towards a digital education can cause a loss of a number of important competences in future teachers since learning and interaction of the subjects of an educational environment will be impacted by a constructed virtual reality. At the same time, training for future teachers involves formation of a number of competences — integral, general and special — and should be future-oriented and prognostic (Radul et al., 2023; Suchikova & Tsybuliak, 2023). Oksana Tsiuniak (2020) is convinced that educational-professional training for teachers is a highly important process since they have to learn new technologies and effectively teach them to students. Research on the types of future teachers' self-realisation under conditions of a digital educational environment will allow finding a number of important scientific facts and revealing the current state of psychological content dimensions of the outlined problems.

Charlotte Bühler (1968) thinks that it is necessary to differentiate between procedural and resultant components looking at the phenomenon of self-realisation. The process is fulfilment of potentialities of an individual's life mission, and the result is completion of the process of realisation of an individual's life and professional intentions. The researcher differentiates between the concepts "self-realisation" and "self-fulfilment", since self-fulfilment is a part of self-realisation. The investigated phenomenon of self-realisation belongs to the category of a humanistic paradigm and has much in common with the concept of self-actualisation of Abraham H. Maslow (1954). Self-actualisation is a peak of the hierarchy of needs which is accompanied by the highest level of professional and life perfection, creativity, compliance with the highest moral standards, objectivity, tolerance, etc. Everett L. Shostrom (1964) regarded self-actualisation as a multidimensional phenomenon and proposed a research method — Personal Orientation Inventory (POI). The researcher associates self-actualisation with "time competence" and "self-support" and holds a belief that self-actualising

individuals live their life at the present time and simultaneously use their past and future to add more meaning to their present. The scientist Viktor Plokhikh (2022) found that students' active use of rationalisation is a natural orientation towards the future. Such an orientation does not contribute to coordinating the effect of defense mechanisms with time competence. It was proved that respondents' life purpose in an optimal profile of time perspective is a key dimension and embodiment of optimistic intentions of life prospects (Zavatska et al., 2023). Students who live the current moment fully and thoroughly prefer conscious control over probable variants of behaviour in a stressful situation (Plokhikh, 2023) that is a time concordance of necessary operations (Nosov et al., 2020; Plokhikh et al., 2021) and can indicate a well-formed time competence of an individual.

The factor structure of mental states of self-actualisation of junior athletes (Popovych et al., 2022) is interesting in the context of the research on self-realization, since the identified types — search for self-actualisation, self-motivation, temporal incongruence, world perception, attitude to cognition — were investigated on the sample of the same age as the respondents of this research. It was found that the mental state "temporal incongruence" is the most dangerous dominant state of the respondents that indicates a low time competence and prevents processes of self-actualisation and, consequently, self-realisation. Another research identified the types of self-regulation readiness of the respondents with disabilities and concluded that the dominant state "reflexive" does not contribute to achievement of the highest results since it focuses attention on "ego" (Prokhorenko et al., 2023). The study on dominant mental states of internally displaced teachers found the types and substantiated that mental states are a dominant psycho-complex of internalized individual-typological characteristics of the research participants (Popovych et al., 2023). It is obvious that the research on the types of future teachers' self-realization under conditions of a digital educational environment will also aim to identify similar psycho-complexes but under different empirical conditions.

Conditions of a digital educational environment involve using advanced informational-communicative and digital technologies. On-line learning, safety of the educational environment (Blynova, Popovych et al., 2022) combining information safety and cyber safety, a change in students' activity in distance learning (Hudimova et al., 2021) come to the fore. It is important to take into consideration probable presence of students with special educational needs in a digital educational environment that, in turn, requires not only creation of a safe and inclusive educational space but also understanding of the specificity of inclusive education, additional support for children with special educational needs in an educational process (Gumennykova et al., 2021; Kalenchuk et al., 2023). Since technical and software support is rapidly improved, a digital educational environment undergoes permanent changes, that, in turn, requires continuous development and education of future teachers and their high stress-resistance (Halian et al., 2021) and tolerance of uncertainty (Halian et al., 2020). The researchers Elvira Luzik

et al. (2023) proposed a model for evaluating the development of special (professional) competences in a digital educational university environment under conditions of dynamic uncertainty. Goal-directed, content-technological, organisational-pedagogical and activity-based components constituted a structure of this model. It was established that cognitive, value-based, motivational, communicative, organisational-operational and reflective criteria are criteria of the development of competences under conditions of a digital educational environment (Luzik et al., 2023). The research of Valerij Radul et al. (2023) also focuses attention on subject-related and communicative components in a teacher's professional development. It was emphasised that the level of formation of these dimensions is of crucial importance in successful teaching. Under conditions of a digital educational environment, due to modern applications and achievements of artificial intelligence, a communicative component becomes highly technological and operational (Mialkovska et al., 2023). Using practices of artificial intelligence requires future teachers to be able to instill an ethical component, decency, respect to intellectual property.

The types of self-realisation are dominant psycho-complexes of internalised individual-typological characteristics of professional activity of future teachers that relevantly reflected the parameters of the research subject under conditions of a digital educational environment.

We proposed a hypothesis that investigating the types of self-realisation and establishing statistically significant correlations with the research parameters of educational-professional training for future teachers will allow finding important scientific facts that will possess novelty and be of scientific interest for organisers of educational and scientific activities in a digital educational environment.

The aim is empirical research and theoretical substantiation of the types of self-realization of future teachers who do an educational-professional training course under conditions of a digital educational environment.

Methods

Methodology

The research applied methodological foundations of the key concepts: self-actualisation Maslow (1954) and Shostrom (1964), self-realisation Bühler (1968), emotion regulation of educational activity Oleksiy Chebykin (2023), value orientations (Antoci, 2019) and creation of a digital educational environment (Kobylarek, Plavčan et al., 2021; Tsybuliak et al., 2023). Modern studies which consider age regularities of adolescence (Shevchenko et al., 2023; Tavrovetska et al., 2023) and reveal content aspects of individuals' new psychological formations in a leading type of mental activity (Blynova, Derevianko et al., 2022; Bokhonkova et al., 2023) were taken into account.

Participants

The representative sample involved students of the final years of pedagogical educational programmes of Bachelor's and Master's studies. We randomly selected the final year students who took educational programmes exclusively under conditions of a digital educational environment at the following institutions: Kherson State University (Kherson region, Ukraine — relocated Ivano-Frankivsk region, Ukraine) and Ivan Franko National University of Lviv (Lviv region, Ukraine). Since application of k-means clustering requires a sufficient number of respondents, the sample size was n = 259 individuals: females (n = 225; 86.87%) and males (n = 34; 13.13%). The descriptive frequency characteristics of the sample are as follows: (M = 22.42; SD = ±4.132; SE=.213; min = 20.00; max = 34.00; Mo = 21; Me = 22.50).

Organisation of Research

The summative strategy used in the research allowed appropriately testing the hypotheses and achieving the aim. Empirical data was collected before the winter examinations in the academic year 2023–2024 in the final year students: the Bachelor's programme — the fourth year and the Master's programme — the sixth year. Anonymous questionnaires with special blanks were created and shared through Google-form to gather empirical data. Anonymity, voluntariness and full awareness of the plan and aim of the empirical research allowed obtaining reliable empirical cross-sections. Ethical committees of the universities approved validity and appropriateness of the proposed experimental work. The research was also approved by National Office Erasmus+ Ukraine. The research complied with the ethical standards declared in Helsinki declaration (World Medical Association Declaration of Helsinki, 2013).

Procedures and Instruments

The version of the questionnaire Personal Orientation Inventory (POI) Shostrom (1964) adapted by the Ukrainian researchers Radul et al. (2023) was applied. The proposed parameters relevantly reflected the phenomenon of self-realisation of adolescents. Fourteen scales were used: time competence (TC); value orientations (VO); creativity of activity (CA); flexibility of behaviour (FB); self-sensitivity (SS); personal spontaneity (PS); self-respect (SR); self-acceptance (SA); notions of the internal world (NIW); synergy (S); acceptance of aggression (AA); rapport (R); cognitive needs (CN) and interpersonal support (IS). Homogeneity of the obtained empirical data by Cronbach (a) was at a satisfactory level (α = .786). Since any activity has not only a procedural component, but also a resultant component, dimensions of motivation were

taken into consideration in the research on the types of self-realisation. The version of the psycho-diagnostic instrument Method for Examining Motivation of Professional Activity (MEMPA) modified by Arthur Rean et al. (2006) and tested by Tsiuniak (2020) was used. Three dimensions were found: internal motivation (IM), external positive motivation (EPM) and external negative motivation (ENM). Homogeneity of the obtained empirical data by Cronbach (a) was at a medium level ($\alpha = .816$). As modern studies show (Kurova et al., 2023; Tavrovetska et al., 2023), in the context of an individual's self-realisation, such dimensions as dispositional optimism, positive and negative expectations can have a considerable impact on professional growth and career development of a young person. The test Life Orientation Test) (LOT) Charles S. Carver and Joan G. Gaines (1987) verified by the researchers Nataliia Tavrovetska et al. (2023) was used. Three scales of the same name were applied in the research. Homogeneity by Cronbach (a) was registered at a medium level $\alpha = .833$ that meets the requirements for empirical data.

Statistical Analysis

The empirical data were processed using the statistical editor MS Office Excel 2007 and the computer programme IBM SPSS Statistics version 29.0.0.0 (241). The graphical editor MS Office Word 2007 was used for presenting a figure. Comparison of the parameters of descriptive characteristics with similar data was performed using Student's t-test. K-means clustering was used to identify the types of self-realisation. Correlations were established by means of Spearman coefficient (r_s), since the empirical data have normal distribution and duplicate the Gaussian curve contours. Validity of using this coefficient was determined by the Kolmogorov-Smirnov λ-test and statistically confirmed at the level $p \leq .050$. The values of correlations at the level $p \leq .050$ and $p \leq .010$ were considered statistically significant.

Results

Descriptive frequency characteristics of the empirical data were identified by all the parameters of the psycho-diagnostic instruments: POI (Shostrom, 1964; the version tested by Radul et al., 2023); MEMPA (Rean et al., 2006; the version tested by Tsiuniak, 2020); LOT (Carver & Gaines, 1987; the version tested by Tavrovetska et al., 2023). The parameters of descriptive frequency characteristics were used: the mean (M); the mean squared deviation (SD) and Cronbach (a), which sufficiently describe the sample parameters and allow for replication of the empirical research. Table 1 gives descriptive characteristics by all the measured parameters.

Table 1

Descriptive characteristics of the investigated parameters (n=259)

Parameters	M	SD	a
Time Competence (TC)	6.76	±2.67	.782
Value Orientations (VO)	11.44	±2.39	.811
Creativity of Activity (CA)	7.11	±2.07	.754
Flexibility of Behaviour (FB)	10.34	±2.79	.921
Self-Sensitivity (SS)	6.05	±1.99	.687
Personal Spontaneity (PS)	8.12	±2.64	.711
Self-Respect (SR)	8.55	±2.78	.703
Self-Acceptance (SA)	8.23	±2.27	.735
Notions of the Internal World (NIW)	6.44	±1.30	.721
Synergy (S)	6.08	±1.35	.756
Acceptance of Aggression (AA)	8.03	±2.52	.856
Rapport (R)	8.89	±2.89	.701
Cognitive Needs (CN)	6.34	±2.09	.688
Interpersonal Support (IS)	43.34	±7.98	.824
Internal Motivation (IM)	4.08	±1.23	.793
External Positive Motivation (EPM)	4.35	±1.37	.743
External Negative Motivation (ENM)	4.22	±1.25	.922
Dispositional Optimism (DO)	25.12	±4.12	.838
Positive Expectations (PE)	12.21	±3.11	.891
Negative Expectations (NE)	7.89	±1.43	.734

Note. M—the mean; *SD*—the mean squared deviation; *a*—Cronbach.

Source. Own research.

The findings by the parameters of descriptive characteristics were compared with the data obtained by other researchers on similar samples. There were no statistically significant differences by the mean between the parameters of POI (Shostrom, 1964) and the data obtained in the research of Radul et al., 2023 by this method. The only positive tendency in the parameter "interpersonal support" ($M = 43.34$; $SD = ±7.98$) attracts attention. Obviously, the martial law actualised this dimension. There were no significant differences by the mean between the parameters of MEMPA (Rean et al., 2006) and the data obtained by Tsiuniak, 2020. There were also no significant differences by the mean between the parameters of "LOT" (Carver & Gaines, 1987) and the data obtained by Tavrovetska et al., 2023. There were insignificant positive and negative tendencies characteristic of junior samples.

In order to find regularities between dependent and independent variables, we established correlations by Spearman coefficient (r_s). The correlation matrix is given in Table 2.

Table 2

Correlation matrix of the investigated parameters (n=259)

| Scale	Coefficient Spearman	Parameters					
		IM	EPM	ENM	DO	PE	NE
TCz	r_s	*.188***	.087	.081	.102	*.114**	.099
	p	.008	.512	.598	.149	.041	.329
VO	r_s	*.143**	.101	.022	*.141**	*.137**	*-.157**
	p	.015	.147	.535	.017	.022	.012
CA	r_s	*.331***	.090	.012	.089	.076	.042
	p	.002	.803	.895	.808	.284	.776
FB	r_s	-.030	.009	.049	.040	-.030	.009
	p	.661	.871	.713	.699	.661	.871
SS	r_s	.095	-.020	-.027	-.022	-.030	-.037
	p	.347	.429	.419	.533	.661	.839
PS	r_s	*.119**	.101	-.020	.102	.089	-.059
	p	.031	.156	.429	.149	.808	.829
SR	r_s	.089	*.111**	-.099	.102	*.113**	.099
	p	.808	.045	.134	.149	.043	.329
SA	r_s	.030	.042	.059	-.032	.102	-.100
	p	.661	.301	.829	.434	.149	.136
NIW	r_s	-.030	-.027	.089	.033	-.037	.033
	p	.661	.419	.808	.802	.839	.802
S	r_s	.100	.049	-.049	.076	.037	-.037
	p	.136	.659	.659	.760	.839	.839
AA	r_s	-.091	-.099	.067	-.076	-.043	.043
	p	.759	.124	.412	.291	.781	.781
R	r_s	.075	.089	-.077	.100	.101	-.020
	p	.759	.808	.765	.136	.156	.429
CN	r_s	*.139**	*.126**	*-.112**	.076	.089	-.089
	p	.019	.031	.044	.760	.808	.808
IS	r_s	.094	.076	-.076	*.111**	.094	-.097
	p	.411	.759	.7659	.045	.411	.401

Note. TC—time competence; VO—value orientations; CA—creativity of activity; FB—flexibility of behavior; SS—self-sensitivity; PS—personal spontaneity; SR—self-respect; SA—self-acceptance; NIW—notions of the internal world; S—synergy; AA—acceptance of aggression; R—rapport; CN—cognitive needs; IS—interpersonal support; IM—internal motivation; EPM—external positive motivation; ENM—external negative motivation; DO—dispositional optimism; PE—positive expectations; NE—negative expectations; r_s—the value of Spearman coefficient; *p*—significance level; *—p<.050; **—p<.010.

Source. Own research.

Figure 1 presents a correlation pleiade of the parameters of self-realisation. The pleiade is given to facilitate perception and analysis of the obtained results of the correlation matrix.

Figure 1

Correlation pleiade of the parameters of self-realization (n=259)
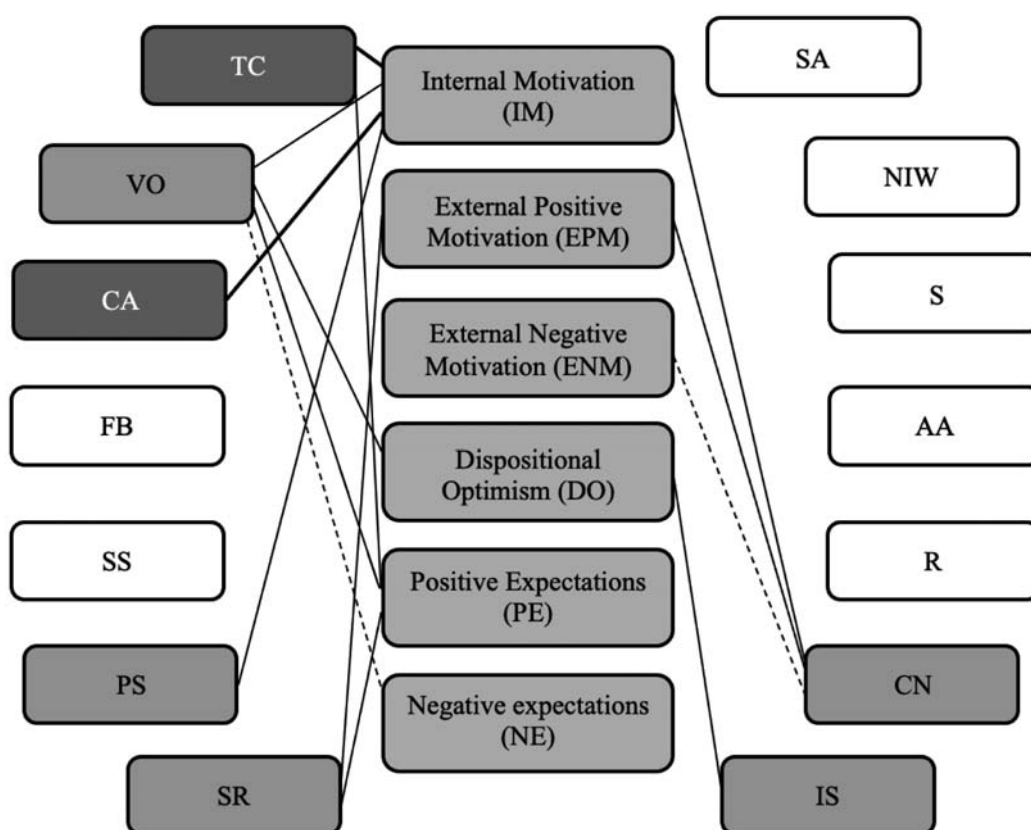
Note: positive correlations at p ≤ .050; positive correlations p ≤ .010; : negative correlations at p ≤ .050; TC—time competence; VO—value orientations; CA—creativity of activity; FB—flexibility of behavior; SS—self-sensitivity; PS—personal spontaneity; SR—self-respect; SA—self-acceptance; NIW—notions of the internal world; S—synergy; AA—acceptance of aggression; R—rapport; CN—cognitive needs; IS—interpersonal support.

Source. Own research.

Thirteen statistically significant correlations between the research parameters of self-realisation at the level p ≤ .050 and p ≤ .010 were registered. The parameter "value orientations" has the greatest number of correlations—four: IM (r_s = .143; p = .015); DO (r_s = .141; p = .017); PE (r_s = .137; p = .022); NE (r_s = -.157; p = .012). It shows that value orientations of future teachers are the most dependent parameter of self-realisation. At the same time, the strongest positive statistically significant correlations were registered between internal motivation and the parameters: TC (r_s = .188;

$p = .008$) and CA ($r_s = .331; p = .002$). Obviously, internal motivation in the dimensions of future teachers' self-realisation remains a key internal resource. Attention should be paid to the three significant correlations of the parameter "cognitive needs": IM ($r_s = .139; p = .019$); EMP ($r_s = .126; p = .031$) and ENP ($r_s = -.112; p = .044$). It can be explained by the fact that cognitive needs depend entirely on a motivational component in the context of future pedagogical activity. No statistically significant correlations were registered by seven parameters "POI" (Shostrom, 1964).

According to the summative research strategy, k-means clustering was used to identify the types of future teachers' self-realization. The parameters by "POI" (Shostrom, 1964) which have statistically significant correlations ($p \leq .050; p \leq .010$) with the research parameters by MEMPA (Rean et al., 2006) and LOT (Carver & Gaines, 1987) were selected for clustering. The empirical data by ($n = 13$) dimensions were divided into an optimal number of clusters ($k = 4$). Since the parameter "value orientations" is the most dependent research parameter, it was regarded as the main characteristic, the rest of the parameters are given in the following order: time competence, creativity of activity, cognitive needs, self-respect, personal spontaneity, interpersonal support, internal motivation, external positive motivation, external negative motivation, dispositional optimism, positive expectations, negative expectations. The minimal number of respondents in a cluster ($k \geq 31$) was empirically established. Further statistically significant parameters which allowed using k-means clustering were found: the sample adequacy $KMO = .698$ (the Kaiser-Meyer-Olkin test). It should not be less $KMO \geq .500$ according to the requirements, i.e. it meets them. Bartlett's coefficient ($p < .001$) is also met. The nucleus of the first cluster is the parameter "value orientations" (VO). Table 3 contains the main parameters of clusters: the beginning of the cluster center and the end of the cluster center.

Table 3
Main parameters of clusters (n=259)

Parameters	Cluster I (k = 34)		Cluster II (k = 73)		Cluster III (k = 93)		Cluster IV (k = 59)	
	a	b	a	b	a	b	a	b
VO	22.00	19.00	18.00	13.00	14.00	10.00	8.00	13.00
TC	14.00	11.00	17.00	14.00	13.00	8.00	6.00	12.00
CA	19.00	10.00	16.00	11.00	15.00	12.00	7.00	11.00
CN	8.00	6.00	7.00	5.00	2.00	9.00	14.00	9.00
SR	12.00	10.00	7.00	4.00	8.00	6.00	3.00	9.00
PS	10.00	6.00	5.00	3.00	9.00	5.00	4.00	10.00
IS	32.00	23.00	33.00	26.00	59.00	39.00	22.00	29.00
IM	11.00	8.00	4.00	9.00	9.00	10.00	3.00	8.00
EPM	14.00	10.00	9.00	6.00	8.00	6.00	5.00	8.00
ENM	7.00	5.00	9.00	7.00	14.00	9.00	3.00	10.00
DO	48.00	32.00	34.00	20.00	9.00	16.00	26.00	12.00

Parameters	Cluster I (k = 34)		Cluster II (k = 73)		Cluster III (k = 93)		Cluster IV (k = 59)	
	a	b	a	b	a	b	a	b
PE	22.00	15.00	17.00	12.00	8.00	15.00	12.00	18.00
NE	10.00	7.00	6.00	3.00	15.00	10.00	6.00	9.00

Note. *a*—beginning of the cluster; *b*—end of the cluster; VO—value orientations; TC—time competence; CA—creativity of activity; CN—cognitive needs; SR—self-respect; PS—personal spontaneity; IS—interpersonal support; IM—internal motivation; EPM—external positive motivation; ENM—external negative motivation; DO—dispositional optimism; PE—positive expectations; NE—negative expectations.

Source. Own research.

Four clusters reflecting the types of future teachers' self-realisation were formed and their main parameters were obtained. The criterion of the difference in observations of *k-means* by all the researched parameters is statistically significant (F < .001). Clusters were named after their dominant parameters.

Cluster I (*k* = 34; 13.13%) is the smallest cluster by the number of respondents. The nucleus of the first cluster is VO (*a* = 22.00; *b* = 19.00), high parameters of SR (*a* = 12.00; *b* = 10.00) and relatively low levels of ENM (*a* = 7.00; *b* = 5.00). The type of self-realisation identified by the key parameter was named "Value-oriented self-realization".

Cluster II (*k* = 73; 28.18%) is the second cluster in size and has a sufficiently great number of respondents. The nucleus of the second cluster is TC (*a* = 17.00; *b* = 14.00), medium parameters of IS (*a* = 33.00; *b* = 26.00) and low levels of PS (*a* = 5.00; *b* = 3.00) and IM (*a* = 4.00; *b* = 9.00). This type of self-realisation was named "Temporal self-realisation".

Cluster III (*k* = 93; 35.91%) is the largest in size. This cluster covers the majority of the sample. The nucleus of the third cluster is ENM (*a* = 14.00; *b* = 9.00), high parameters of IS (*a* = 59.00; *b* = 39.00) and low levels of CN (*a* = 2.00; *b* = 9.00) and PE (*a* = 8.00; *b* = 15.00). Combination of these dimensions allowed for naming this type "Passive self-realisation".

Cluster IV (*k* = 59; 22.78%) is the third one in size. It is characterised by the dominant parameter CN (*a* = 14.00; *b* = 9.00), a number of medium levels and low levels by VO (*a* = 8.00; *b* = 13.00) and CA (*a* = 7.00; *b* = 11.00). The type of self-realisation identified by the outlined parameters was named "Pragmatic self-realisation".

Discussions

Theoretical studies showed that the problem of self-realisation of young people is highly topical and gains more importance under changed conditions of social reality (Blynova et al., 2020; Kobylarek et al., 2022). Pandemics and war conflicts occurring

in the world have led to development of a digital educational environment. Active use of social networks and placing educational technologies in distance and mixed formats have reduced interpersonal interaction and physical activeness of respondents (Hudimova et al., 2021). At the same time, we found a positive tendency for an increase in the parameter (see Table 1) "interpersonal support" (M=43.34; SD=±7.98). Obviously, the obtained high results reflect the deficiency in this phenomenon and existential need of the respondents in the context of a digital educational environment. The established statistically significant correlations (see Table 1 and Figure I) demonstrated a half of regular dependences since seven out of fourteen parameters have statistically significant correlations. It can be explained by the fact the parameters with the greatest number of correlations (value orientations) and the parameters with the strongest correlations (time competence, cognitive needs) determined contours of the future clusters. Selection of four clusters (see Table 3) allowed meeting an important requirement ($k \geq 31$) and finding quantitative and qualitative parameters of four populations. The Kolmogorov-Smirnov λ-test allowed verifying significant differences of the clusters ($p \leq .050$) and validly determining four types of future teachers' self-realisation. The obtained types under conditions of a digital educational environment confirmed that the dominant parameters which are nuclei of each cluster are the parameters which do not contradict the results of relevant studies (Halian et al., 2020; Kurova et al., 2023). Cluster III, the biggest one in size, ($k = 93$; 35.91%) (see Table 3) somewhat unexpectedly combined respondents with high parameters of external negative motivation and a low level of cognitive needs. It can be explained by the fact that external negative motivation combined motives which are not directly related to the process and results of educational-professional activity, but rather reflect future teachers' attitude towards it. This motivation is aimed at avoiding punishment, criticism or condemnation and does not have a constructive coping strategy that does not contradict the results obtained by Olena Bondarchuk et al. (2023). The researcher Plokhikh (2022) empirically found and that defense mechanisms limit cognitive processes of students' educational activity. We assume that the obtained combination of external negative motivation and a low level of cognitive needs does not encourage future teachers' self-realization and indicates a lack of it. At the same time, the obtained type was named "passive self-realisation" given the content parameters of the investigated phenomenon. We also pay attention to low parameters of "positive expectations", regarded as a consequence of external negative motivation. High levels of the parameter "interpersonal support" indicate its compensatory nature or a psychological mechanism of displacement in future teachers' professional activity. Determinants of the biggest cluster were analyzed. We continue with analysis of the smallest cluster I ($k = 34$; 13.13%) (see Table 3), which is value-based embodiment of the respondents' self-realisation. A value-oriented type of self-realisation is characterised by a high level of value orientations of future professionals and high indexes of the parameter "self-respect" in combination with little external negative motivation. Obviously, future teachers

with this type of self-realisation are ready to devote themselves to pedagogical activity and consider it to be the meaning of their life. The other two clusters—cluster II ($k =$ 73; 28.18%) and cluster IV ($k = 59$; 22.78%) (see Table 3)—are between the above clusters by their size and manifestation of the investigated phenomenon. It is obvious that temporal and pragmatic self-realisations are important types which underscore the dominant role of the respondents' time competence and cognitive needs.

The obtained statistically significant correlations of dependent and independent variables of the investigated phenomenon and the identified types of self-realization allowed confirming the hypothesis and establishing important scientific facts which possess novelty and should be implemented in a digital educational environment.

Conclusions

We empirically studied and theoretically substantiated that the types of self-realisation are dominant psycho-complexes of internalised individual-typological characteristics of future teachers' professional activity that relevantly reflected the parameters of the research subject under conditions of a digital educational environment. The correlation matrix and the correlation pleiade demonstrated thirteen statistically significant dimensions. It was found that the most important and the most dependent parameters are: "value orientations", "time competence", "cognitive needs" and "creativity of activity". *K*-means clustering allowed identifying four types of future teachers' self-realisation: "Value-oriented self-realisation", "Temporal self-realization", "Passive self-realization", "Pragmatic self-realisation". It was noted that the biggest type "Passive self-realisation"—cluster III combined high levels of external negative motivation and low levels of cognitive needs. It can be explained by the fact that external negative motivation is not directly related to the process and results of educational-professional activity, but rather reflects future teachers' attitude towards it. It was emphasised that future teachers with a value-oriented type of self-realisation are ready to devote themselves to pedagogical activity and consider it to be the meaning of their life. It is recommended that the obtained scientific facts should be implemented in a digital educational environment designed for training future teachers.

Research Restrictions

The survey was conducted using standard blanks of valid questionnaires created in Google Forms. In spite of a short instruction given above the statements and the recommended time for filling out the survey, the respondents could deviate from the indicated timing. We assume that not all the respondents were the final year students. Since the survey was anonymous, it was difficult to control the time spent on filling out

the forms and the year of study. There were many more female respondents, that could also affect the empirical results. Since the differences of gender differentiation were not found, there are no reasons for making assumptions about their significance, we only established the fact of their presence. The research was carried out under conditions of martial law and we did not know the exact whereabouts of the respondents and did not try to identify them. We assume that the responses of forced migrants can differ from those of the research participants who were in the occupied or liberated territories, or in the territory which was not invaded. We hope that the outlined restrictions did not have a significant impact on identifying the types of future teachers' self-realization.

Cognitive value

It was found that the types of self-realisation are dominant psycho-complexes of internalised individual-typological characteristics of future teachers' professional activity that relevantly reflected the parameters of the research subject under conditions of a digital educational environment. We developed and implemented a summative research strategy using reliability coefficients and *k*-means clustering. The parameters of the types of future teachers' self-realisation were identified and described. Our research possesses cognitive, scientific and theoretical value and can be implemented in educational practice.

Acknowledgements

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