

# Influence of tolerance to uncertainty on personal and professional development of pilots during aviation specialists' training

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**Abstract:** *The application of a new pragmatic educational model in the information environment of the higher technical education institution, which corresponds to the innovative and perspective model of society development, determined the transition from the process approach in the organisation of professional training of future aviation specialists to a reflective and effect-oriented one. It forms the basis of training objectives related to providing the country with specialists in aviation industry. The aim of the study is to theoretically substantiate, develop and experimentally test the effectiveness of the professional training model for future specialists under the conditions of uncertainty of the educational process of higher education institutions on the basis of a reflective approach. The result of the experimental stage of the study, as the foundation of the personal and professional development of the student, confirmed the effectiveness of the model based on the reflective approach. The systemically important core of the study considered the goals and results implemented in the educational and informational environment of the National Aviation University with the help of appropriately constructed psychological and pedagogical conditions, which were implemented at each stage of professional training with the innovative educational technologies.*

**Key Words:** *integral personal quality, aviation specialist, aspects of the human factor, educational motivation*

## 1. INTRODUCTION

The creation of a global educational network, information and synergetic approach as a systemic reform of the European, national and institutional levels of higher technical education, led to the identification and substantiation of problems, common for the world community, in the professional training of future aviation specialists as a systemic process of purposeful personal changes or responses to incentives, are perceived as complex and

changing variables that allow for the existence of several fundamentally different interpretations [1]. This contributed to the establishment of a global trend in the organisation of training, considering it as a product of the outside world image perceived by the inner world of the individual as a professional entity, which would contribute to the implementation of full - fledged subjective position in the learning process.

The application of a new pragmatic and result-oriented training model in the educational and information environment of the institution of higher technical education. This corresponds to the innovative and perspective model of development of society and the world as a whole, determined by the transition from the process approach in the organisation of professional training of aviation specialists to a reflective and result-oriented one. This forms the basis of training related to providing the country with specialists who are able to competently, independently and responsibly solve multifunctional tasks in conditions of ambiguity, as an attribute of everyday life associated with unpredictable events and a dynamic paradigm of their control, ready for constant personal and professional development and growth of social and professional mobility. In the world of defined tasks, professional training of aviation specialists will be considered as the development of a special way of interaction between students and the way students interact with the external environment, the centre of which becomes the subject of their future professional activity, to which the specialist's life activity should be directed. Mastering this subject as a result, providing a creative response to situations of uncertainty involves the inclusion of the following components: epistemological, as mastering the system of professional knowledge that reveals the essential properties of this subject; axiological, i.e. reconstruction of the system of personal values, norms and principles; praxeological, which contains the mastery of specific techniques for solving psychological problems; personal, as self-awareness from the standpoint of professional compliance. This suggests that the complex task of future specialist training is the development of ability to live in conditions of information ambiguity, which ensures the constructiveness and success of its use in modern society, which is the best way to implement the content of future professional activities on the basis of a reflective approach [2], [3].

This idea is clearly confirmed by researcher M. Comadena, who showed that in the conditions of “brainstorming” subjects who showed tolerance for uncertainty, offered many more ways to solve problems [4], and D. Tegano confirmed the close link between creativity and tolerance for uncertainty [5], emphasising that it is negative emotions that trigger the mechanism of cognitive dissonance reduction (risk acceptance) [6], [7], [8]. In the context of a personal approach to the training, it was concluded that there is a certain integral quality (“tolerance for uncertainty”) that allows individuals to act successfully in unpredictable situations [9]. Focusing on the work of A. I. Averyanov [10], M. S. Dmitrieva [11] and V. G. Kremen [12] the authors outline the main signs of uncertainty, namely:

a) in the objective sense is the presence of several ways of equally possible courses of events;

b) in the subjective sense – a situation in which a person has an objective opportunity to choose from several equally possible alternatives, but, in this case, there are no: necessary information; resources; semantic value of the situation and its consequences, and hence no desire to resolve the situation.

In this study, ambiguity tolerance is considered as an integral personal quality of the future airmen, which determines ability to respond positively to situations of uncertainty, to act in unclear objectives and goals, incomplete availability of source information. However, despite a significant increase in the general and professional training of “front - line” aviation personnel (flight crew members and airline operators, air traffic controllers who directly ensure

flight safety), at least  $\frac{2}{3} - \frac{3}{4}$  of the total number of aircraft accident in civil aviation were caused by the human factor. And although, now, the level of flight safety has become incomparably higher than it was 50–70 years ago, the impact of the human factor on the occurrence of aircraft accidents has not changed. Given this impact (both positive and negative), ICAO has summarised the practices of leading airlines in this area and provided general recommendations for studying the impact of the human factor in safety precautions, paying particular attention to factors such as interaction between crew members and operational context (organisational and regulatory factors, as well as environmental factors [13]. The purpose of the study is to theoretically substantiate, develop and experimentally test the effectiveness of professional training model for future aviation specialists in the conditions of uncertainty of the educational process on the basis of a reflective approach. The object of research is the professional training of future aviation specialists in higher education institutions. The subject of the research is the development of training model for future aviation specialists in conditions of uncertainty.

## 2. THEORETICAL OVERVIEW

It is known that the traditional training in higher education institutions, which focuses only on the subject training of the specialist, forms the so-called context and algorithmic vision of the world, thus reflecting only educational environment and not informational and synergetic space that includes indefinite problems, hypotheses, and variable axioms. As a result of such training, the aviation specialist is not ready for independence in the process of forming new knowledge and skills; responsibility in project and personal activity, which systematises and structures the components of future professional activity [14], [15], [16]. Thus, as a result of theoretical and empirical research [8], among the most pressing problems of professional training of future aviation specialists in technical institutions of higher education, we have identified: the development of independence and responsibility in students; features of adaptation to new living conditions; conditions of personal development and professional development of students in the process of professional training; moulding personal and social maturity; values-based orientations and the ratio of internal and external motivation to study; conflicts in the educational process in the technical institution.

The above-mentioned problems of professional training confirmed by the views of scientists R. M. Jafarzade [17], R. S. Jensen [18], O. M. Reva [19], [20], A. I. Wenden [21], on the fact that the main task of the higher educational institution is development of ambiguity tolerance in the professional identity of the specialist, the main characteristics of which are dynamism, independence, responsibility, success, ability to educate throughout life, is not solved. That is why the subjective attributes of the student's personality (new mental formations, goals, requirements, motives, inclinations and abilities, personality development) in conditions of uncertainty should act as system - forming conditions for optimising training, since they are responsible, first of all, for the successful actualisation of professional knowledge, skills and abilities, ensuring the harmonious professional development of the student implementing the personal trajectory of successful learning throughout life. Based on these considerations, the main conceptual idea of the study will be that timely identification and awareness of both teachers and students of the need to take corrective action on factors that destructively affect the student's educational activity and professional development will contribute to the unification of the prospects for personal and professional development, increasing the efficiency and effectiveness of training. Despite the multifaceted research of J. B. Campbell [7], S. J. Guastello [22], Human Factors Module [23], O. M. Reva [24], V. V.

Kamishin [25], S. D. Leichenko [26], devoted to the personal growth and professional becoming of aviator, there are still certain challenges. There are inconsistencies between the requirements set out in the standards and recommended practices of the International Civil Aviation Organisation (ICAO) and the International Air Transport Association (IATA), and the actual readiness of future professionals to ensure flight safety in normal, abnormal and emergency situations. The need to create a flexible open pedagogical system of continuous training of airmen in the information and educational space and the lack of existing feedback, which is necessary for the organisation of operational correction of the educational process; between the need to monitor, design and forecast an effective educational process and outdated methods of assessing productive knowledge and integrated skills (competencies). Awareness of positive internal motivation for the educational process and the lack of reflective culture, allows us to consider the educational system as a whole, as a spatio-temporal model of personal and professional growth, which should include information (knowledge, skills, abilities), developmental (dispositions, capabilities) and educational (needs, motives, goals, new mental formations) components [27].

From the perspective of the mentioned above, the EUROCONTROL document “Human Factors Module – A Business Case for Human Factors Investment” deserves unconditional attention. It defines three strategies of approach to the aspects of the human factor, the most important of which is the so-called “proactive approach” as the ability of a specialist to actively choose a goal and corresponding means of its achievement; take the initiative; be responsible not only for himself, but also for the actions of the team; for the implementation of the task, that help to solve problems before they arise. At the same time, from the range of provisions that are part of the ICAO concept in the field of flight safety, in terms of human impact, one of the most important is “the attitude of aviation employees to dangerous actions or conditions”, thus reflecting the degree of “safe” corporate culture. In addition, the problems of the human factor are of particular importance in decision-making, because, on the one hand, the professional activities of the future aviation operator can be considered as a continuous chain of decisions made and implemented in explicit and implicit forms, and on the other hand, according to American scientist S. N. Roscoe, the vast majority of aviation accidents are the result of both erroneous technical and communicative decisions made by crew members in the course of their work [28]. That is why, taking into account the above, not only the structure and content of productive knowledge, formed on the basis of the changing information environment, in which both the educational system of professional training of aviation specialists in general, but also the integrated ability to operate with this knowledge become important; the expediency of determining the content of professional necessity and the vital importance of professional training. Equally important is the development of students' ambiguity tolerance as an integral personal characteristic, which is closely related to the cognitive and stylistic characteristics of a person and the peculiarities of decision-making in situations of personal choice, critical attitude, ability to identify and understand psychological and professional problems that may arise in future professional activities and interpersonal relationships. It is known that the decision-making process of the aviation operator has always attracted the attention of experts and researchers such as A. N. Reva [29], Yu. K. Strelkov [30], F. Breche [31]. Thus, the model proposed by the researcher F. Breche identifies not only the situation, but also the difficulties of decision-making, indicating the factors that further affect the complexity of these decisions. It is noted that thinking and decision-making required in situations characterised by uncertainty include, as a rule, cognitive complexity, lack of time, and stress, where the degree of uncertainty is characterised by lack (or absence) of information, as well as uncertainty of its relevance; cognitive complexity is determined by

the number of discriminators and operators in the algorithms that describe the solution to the problems. In addition, a professional task (problematic flight situation), which is characterised by a certain novelty and complexity, requires an appropriate reserve of time to solve it, and stress, as a non-specific reaction of the body in response to any adverse effects, contributes to the body's adaptation to new conditions, or eliminating this effect and returning it to normal as soon as possible [32].

It is known that the checklist of the World Flight Safety Foundation (FSF) includes about 150 hazards, structured in eight groups at the psychological, professional and organisational levels. Presented in [33] model of stress and ways to deal with it (Oxford Aviation Training) show how the feedback system helps to determine the degree of stress of the aviator when solving a complex flight task, characterised by uncertainty, cognitive complexity and lack of time, reducing themselves, the level of negative requirements perception and increasing the necessary ability to solve a complex problem and reduce stress.

The cognitive dissonance is also of particular interest. In a problematic situation it is perceived as an additional component of stress, characterised as a state of psychological discomfort of the individual caused by a collision of conflicting ideas in his mind: ideas, beliefs, values or emotional reactions. As a result, there is a discrepancy between a person's attitudes and actions. The individual "adjusts" his thinking to rationalise the conflict within himself, as a result of this style of thinking ("it's nothing much") is extremely dangerous to flight safety. According to statistics, the occurrence of 12% of abnormal situations (AS) was prevented due to the collaborative experience, i.e. a set of coordinated, purposeful and practically implemented collective actions of the flight crew to localise the danger; 47% of AS – at the level of cognitive experience (individual experience of each crew member, based on practical knowledge, competencies, professional skills acquired during professional activities), 24% of AS – through volitional action, when difficulties encountered in flight were overcome due to strong-willed efforts, high consciousness, and responsibility; 14% of AS were overcome at the level of motor experience as a set of motoric automatisms; less than 1% – biological experience (instinct of self - preservation) [26].

Thus, from a wide range of factors that determine the safety of the aircraft operator, we can identify the main four that determine ability to counteract the danger [32]:

- a) biological factors, arising from the natural qualities of a person and manifested in the subconscious regulation;
- b) the factors that determine the individual qualities of psychological reflexion and mental functions of a person;
- c) the factors arising from personal experience, skills, knowledge, abilities, work;
- d) the factors that characterise the personal orientation, i.e. motives, interests, attitudes.

The researchers L. F. Lester [28] and V. A. Goryachev [8], give an assessment of the so-called dangerous qualities (strategies, attitudes, properties) of behaviour, operational thinking and decision-making, which were separated by American scientists who studied the irrational features of the professional mental abilities of pilots. These studies were based on the statement that the ability to think correctly and make the right decisions of the pilot can and should be taught in the initial training. As a result of the research, the ERAU handbook was developed, which identified psychologically dangerous types of thinking (beliefs, attitudes, strategies) that influence the decisions of the pilot-operator, and offered professional and situational exercises for their diagnosis [34]. In addition, recommendations were developed for the training process, where the attention of future pilots focuses on the factors that determine the strategies of the decision-making process in the context of the tolerance for uncertainty: the pilot, the aircraft

and the environment, where the pilot is associated with training factors: experience, health status, stress resistance, degree of fatigue and other factors. In [33] the author provides countering action for the correction of such dangerous qualities of behaviour as ignorance and criticality in thinking and acting; invulnerability and self-control as an element of increasing reliability; independence and self-determination in decision-making and its implementation, and the development by scientists of a number of professional situational exercises for diagnosis and correction of dangerous decision-making strategies contributed to a decrease in the number of accidents due to the human factor by at least 5 - 20% [35], [36], [37], [38].

### 3. MATERIALS AND METHODS

To address the goal formulated in the study, the following criteria were chosen to determine the cognitive activity of the future aviation specialist in the uncertainty of the educational process. The first criterion – “Specificity of perception and attitudes” forms the individual's assessment of their abilities, i.e. the system of ideas of the individual, which actually plays a major role in the process of tolerance development as an important professional quality of the pilot. In this perspective, it is worth considering two categories of perception and attitudes: attitude to the conditions of cognitive activity (Learning climate) – perception and assessment of specific conditions in the direct cognition process and attitude towards classroom tasks, their direct perception and evaluation. It has been proven that the intellectual microclimate of learners is influenced by two types of attitudes and perceptions: “a sense of positive acceptance”, i.e. mutual understanding, and “a sense of comfort and order” [39], [40], [41]. In addition, it has been proven that the phenomena of “individual personal responsibility” and “positive group interdependence” also have a beneficial effect on the processes of personal and professional growth of students in the learning process. Researchers such as G. Mandler and S. Santostefano [42], [43] noted that a positive emotional mood in the educational process contributes to the success of the cognitive process, which led to the conclusion that teachers should be aware of how to achieve “physical” and “emotional” comfort in the classroom so that students feel relevant during the learning process. At the same time, it should be noted that the basis of the study of pedagogical activity should be to determine the degree of its identity with the interests of students. That is why in the context of the criterion under consideration, such parameters as understanding the tasks and sources of their implementation (conditions, abilities, efforts, complexity of tasks) are of particular importance). A special place in the study of cognitive activity of students is occupied by the second criterion of learning – “Acquisition and integration of knowledge”. The basic principle of cognitive activity is as follows: the acquisition of new knowledge includes a subjective process of interaction between the fact that the student should not only be taught fundamental knowledge, more important is the development of thought processes and ability to advance arguments. It is necessary if we aim to promote personal and professional growth of the student's creative personality. Taking into account the third criterion of training “Expansion and improvement of knowledge” for the development of tolerance for uncertainty of future specialists, special attention is drawn to more significant changes related to previously learned information, which contributes to the formation of new, more productive vision of certain events.

Examining the fourth criterion of the cognitive model of learning “Conscious use of knowledge”, the scientist J. Elliot [41], noting the discrepancy between “real life” and “practical training”, argued that only when a student is focused on long-term projects, he manages to put into action all available skills to show the ability to independent (self-regulated) activities. To do this, we propose the following conditions: the tasks offered to

students must be completely personality-oriented (independent choice of topics for term papers and dissertations, reports, etc.). The student must have a conscious sense of self-control (a student who does not possess this quality, unknowingly “delays” his development). A constant condition for the development of abilities and talents by the student should be the constant presence of a tutor (mentor). A distinctive feature of the tasks that promote the development of tolerance to uncertainty, skills, and abilities of self-regulation, is their reality, which expands the range of knowledge and significantly increases the possibilities of cognitive activity of the student. The above allowed us to conclude that the use of productive knowledge is consciously characterised by the fact that: it requires thinking and action that covers a long period of time; directed by the student; focuses on real issues and problems that attract the cognitive activity of the student, giving the opportunity to say that this parameter is, in our opinion, the core of the model “Learning Options”.

An analysis of the psychological and pedagogical literature related to the study of the fifth criterion of the cognitive model, namely, the parameter “Productivity of the mindset”, shows that scientists such as R. J. Marzano [45], D. N. Perkins [42] and others, highlighting the qualities that characterise the future operator (the ability to respond quickly to new information; strive to be accurate and objective; display perseverance, even if answers and decisions are contradictory; display unconventional approaches to the situation; avoid impulsivity). All the listed qualities show the priority of “intelligence capabilities” in cognition, that is, the formation of a certain mindset should be the value of learning [46], [47], [48]. At the same time, the indicators of the productive mindset of future aviation specialists will include: self-regulation (knowledge and understanding; planning; awareness of the necessary resources; anticipation of consequences; assessment of effectiveness); critical thinking (accuracy; clarity of perception; ability not to succumb to impulsiveness; defending a position; reflection); creative thinking (intensive involvement in the implementation of tasks; manifestation of great efforts in concentrating their knowledge and capabilities; manifestation of responsibility and support of personal evaluation criteria; search for innovative approaches to the studied situations).

#### **4. RESULTS AND DISCUSSIONS**

Higher technical education today should be considered as a synergetic educational and social environment in conditions of tolerance to uncertainty, which should provide future airmen with the opportunity to fully participate in the social and professional life of society after graduation. The use of a reflective approach allows us to consider a number of psychological and pedagogical problems that the student has to solve in the process of training independently or in communication with the teacher. These problems include: substantiation of the professional significance and necessity of all subjects included in the curriculum of professional training of aviation specialists; awareness of the need for in-depth analysis of the structure and content of educational subjects in order to go beyond the reproduction of acquired knowledge to the level of their creative use; the ability to dissect multiple relations in interdisciplinary interaction or at the level of the entire educational process as a whole, which ensures the development of integrative qualities of the student; specification of the result to be achieved in the course of professional training with the adoption of an individual model of professional readiness in terms of tolerance for uncertainty. The solution of these and other problems will help to realise the need for constant expansion of knowledge, taking into account the individual characteristics of the student [49], [50]. This includes overcoming the “identification barrier” caused by the dissimilarity of educational and professional activities,

and the difference between the objectively set goal (specialisation) and motives for learning in terms of a strategy of tolerance to uncertainty with full acceptance of the social role of the future aviation specialist; the ability to see each situation of educational activity as part of a single system of professional development, the adoption of criteria for personal self-esteem in relation to the main purpose of university education [51], [52], [53].

Thus, the solution of the above problems is possible only if the student perceive training program as an orderly, relevant, holistic, logically and organisationally self-regulating system of professional development through the development of personal qualities, scientific outlook, cognitive processes, mastering general skills; development of professional thinking; formation of individual style of activity; optimisation of the individual system of life and professional values; formation of a professional position, i.e. when the specialist has the appropriate level of tolerance for uncertainty. Then the introduction of a reflective approach to the educational process will facilitate the transition from the activity controlled by the teacher, to self-determination of the impact of learning on personal development; overcoming the differences between the nature of training activities and the actual practical actions of a specialist who will work in the relevant aviation industry. In this case, an essential feature of the use of a reflective approach based on a cognitive model of perception is: the most complete consideration of significant learning factors; practical implementation of all theoretical provisions aimed at improving the quality of education; focus on the flexibility of pedagogical influence; priority of personal activity of students over pedagogical influence. It is this kind of attention to educational activity, if it is sufficiently stable and occupies a significant place in the personality of the person who is studying, forms the strength to show patience, sufficient efforts for positive change. However, if in the process of learning this setting is not supported by other motivating factors, it will not provide the desired effect.

The observational stage of our study confirmed this position with the following results: it indicated a certain increase in the attendance of students majoring in 272 “Aviation” program, at the same time the results showed insufficient and low levels of their personal attitude towards educational process in general, as shown in Tables 1–4. The number of participants in the observational stage of the experiment was: I year – 32 people, II year – 20 people, III year – 12 people, IV year – 8 people, i.e. the total number of students who participated in the observational experiment was 72 people. Symbols, which are presented in Tables (1–4): 1 – standard educational process; 2 – establishing interaction with other subjects; 3 – significant professional achievements; 4 – self-organisation; 5 – result; 6 – satisfaction of vital needs; 7 – external organisation of the educational process; 8 – advice to teachers; 9 – advice on the organisation of the educational process; 10 – the total number of answers; N – It is necessary; W – I want; C – I can.

Tables 1 and 2 of the experiment present the method of calculating the total number of responses for each horizontal position.

Table 1 – Distribution of answers by selected items

		1	2	3	4	5	6	7	8	9	10
N	I	24.1	5.4	2.5	23.6	4.9	1.7	20.7	9.9	12.3	203
	II	–	4.2	5.3	–	–	0.1	30.6	8.1	50.7	284
	III	16.1	6.5	3.2	4.8	–	6.5	17.7	12.9	32.3	62
	IV	27.9	8.9	7.8	20.0	8.5	13.9	4.8	3.0	6.1	165
W	I	5.7	4.4	6.3	8.9	12.7	19.0	11.4	6.9	24.7	158
	II	0.1	5.6	6.3	0.1	–	11.6	16.9	8.1	50.7	284



	III	–	5.1	10.3	17.2	–	3.4	17.2	8.6	37.9	59
	IV	9.8	7.5	15.0	15.8	12.8	19.5	7.5	0.8	11.3	133
C	I	31.5	11.0	3.9	32.3	11.0	7.8	1.6	0.8	–	127
	II	35.6	24.0	7.7	27.9	–	2.9	–	–	1.9	104
	III	33.3	4.8	4.8	28.6	–	19.0	–	–	9.5	21
	IV	25.0	9.0	13.0	16.9	4.0	29.0	1.0	1.0	2.0	100

Table 2 – Distribution of answers by academic years

		1	2	3	4	5	6	7	8	9	10
I	N	24.1	3.4	20.5	23.7	5.9	1.7	20.7	4.9	12.3	203
	W	5.7	4.4	6.3	8.9	12.7	19.0	11.4	6.9	24.7	158
	C	31.5	11.0	3.9	32.3	11.0	7.8	1.6	0.8	–	127
II	N	–	4.2	5.3	–	–	0.1	30.6	8.1	50.7	284
	W	0.1	5.6	6.3	0.1	–	11.6	16.9	8.1	50.7	284
	C										
III	N	16.1	6.5	3.2	4.8	–	6.5	17.2	12.9	32.3	62
	W	–	5.1	10.3	17.2	–	3.4	17.2	8.6	37.0	58
	C	33.3	4.8	4.8	28.6	–	19.0	–	–	9.5	21
IV	N	27.9	7.9	7.9	20.0	8.5	13.9	4.8	3.0	6.1	165
	W	9.8	7.5	15.0	15.8	12.8	19.5	7.5	0.8	11.3	133
	C	25.0	9.0	13.0	16.0	4.0	29.0	1.0	2.0	2.0	100

Tables 3 and 4 present the method of calculating the average number of responses per member of this group (in this case – academic year).

Table 3 – Distribution of answers by selected items

		1	2	3	4	5	6	7	8	9	10
N	I	1.44	0.32	0.15	1.35	0.35	0.21	1.11	0.29	0.74	34
	II	–	0.43	0.54	–	–	0.11	3.11	0.82	5.14	28
	III	0.63	0.25	0.13	0.19	–	0.25	0.69	0.5	1.25	10
	IV	4.6	1.3	1.3	3.3	1.4	2.3	0.8	0.5	1.0	16
W	I	0.26	0.21	0.29	0.41	0.59	0.88	0.53	0.32	1.15	34
	II	0.07	0.57	0.64	0.14	–	1.18	1.71	0.82	5.0	28
	III	–	0.19	0.38	0.63	–	0.13	0.63	0.32	1.38	10
	IV	1.3	1.0	2.0	2.1	1.7	2.6	1.0	0.1	1.5	16
C	I	1.18	0.41	0.15	1.21	0.41	0.29	0.06	0.03	–	34
	II	1.32	0.89	0.29	1.04	–	0.11	–	–	0.07	28
	III	0.43	0.6	0.6	0.38	–	0.25	–	–	0.13	10
	IV	2.5	0.9	1.3	1.6	0.4	2.9	0.1	0.1	0.2	16

Table 4 – Distribution of answers by academic years

		1	2	3	4	5	6	7	8	9	10
I	N	1.44	0.32	0.15	1.35	0.35	0.21	1.11	0.29	0.74	34
	W	0.26	0.21	0.29	0.41	0.59	0.88	0.53	0.32	1.15	
	C	1.18	0.41	0.15	1.21	0.41	0.29	0.06	0.03	–	

<b>II</b>	N	–	0.43	0.54	–	–	0.11	3.11	0.82	5.14	28
	W	0.07	0.57	0.64	0.14	–	1.18	1.71	0.82	5.0	
	C	1.32	0.89	0.29	1.04	–	0.11	–	–	0.07	
<b>III</b>	N	0.63	0.25	0.13	0.19	–	0.25	0.69	0.5	1.25	10
	W	–	0.19	0.38	0.63	–	0.13	0.63	0.32	1.38	
	C	0.43	0.6	0.6	0.38	–	0.25	–	–	0.13	
<b>IV</b>	N	4.6	1.3	1.3	3.3	1.4	2.3	0.8	0.5	1.0	16
	W	1.3	1.0	2.0	2.1	1.7	2.6	1.0	0.1	1.5	
	C	2.5	0.9	1.3	1.6	0.4	2.9	0.1	0.1	0.2	

As a result of ascertaining experiment it is established that the ratio of internal and external motives in the structure of student's educational motivation largely depends on the general level of their personal development, needs and values-based orientations, and also on the organisation of educational process, as well as from the organisation of the educational process: the teacher's behaviour model, the specifics of the communicative educational environment, activity stereotypes.

Since the empirical study was conducted on students–future pilots, to present different cases of tolerance for uncertainty, we will take the findings to research by a number of scientists [22] and use them for analysis in the student audience. Thus, typical for a large number of first-year students is the prospective uncertainty, which is clearly manifested at the stage of professional choice; This uncertainty was no less relevant for fourth–year students as a problem of employment after graduation. Retrospective uncertainty is specifically manifested in the educational process of students of I–IV years, the whole period of which is devoted to the transition from cognitive uncertainty (lack of knowledge about the subject) to tolerant certainty (set of formed competencies), the optimality of which is often blocked by a number of reasons; lack of necessary abilities and inclinations in students; insufficient application of efforts to study, etc.

Technical uncertainty is also inherent in student life, in which there is competition between two main systems: personal development and professional growth of the student. Stochastic uncertainty caused by the conflict between the linear nature of perceptions of life events, their causal relationships at the level of everyday thinking, and nonlinear logic in real society, leads to uncertainty of students in their ability to effectively solve personal and professional problems. Uncertainty of the state of nature can be projected on the fact that a significant number of students due to the peculiarities of their age may not take into account the capabilities of their body in the implementation of the decisions, and uncertainty of targeted counteraction often manifests itself in conflicts with students: teachers, administration. Uncertainty of goals is closely related to the learning motivation, when the choice of specialty and direction of training is due to external motives, and uncertainty of conditions is most evident in the interaction of students with the administration (faculty, institute), whose activities are subject to a clear system of laws and rules. Linguistic uncertainty is usually manifested in the relationship of students with teachers, when the former have not sufficiently mastered the basic terms of the relevant disciplines, uncertainty of action is associated with the fact of diversity of life of a student who has a certain social role; included in the system of interpersonal relations in the educational process; experiences a number of vital needs.

One of the common phenomena, closely related to the problematics of personal attitude to uncertainty, is the situation of professional self–determination, which is associated with taking responsibility for future life. Real life often breaks the initial attitudes, including a

person in conditions that may not coincide with his ideas about the future. According to a study of the problem of professional uncertainty, it occurs in three main types of insufficiency: the knowledge available to the professional; knowledge in the professional sphere as such; inability of a professional to understand which of the options corresponds to the current situation [27]. Researcher V. A. Bodrov [14] describes the coherence of a person's abilities and aptitudes as follows: "Only the harmonisation of the relationship between the vector "I can" (abilities formed on the basis of dispositions) and the vector "I want" (dispositions as a direction of particular qualities) provides uncomplicated professional development of individuality, setting the career vector as a stable motivational focus on getting a profession, supported by real opportunities".

Thus, given the basic features of uncertainty as an integral attribute of human life (multidimensionality, polysystemity, continuous linearity, the presence of many objective and subjective conflicts and the need to make decisions with insufficient information), it has been proven that the process of personal development of student is filled with situations of uncertainty of different levels of significance: from decision-making in current situations in a competition of internal needs and interests, and the lack of time for their implementation, to solving strategic problems of life and professional self-determination.

Based on the fact that we have accumulated enough research data on the cognition processes, it allowed us to form an innovative approach to learning in the experimental group of the formative experiment, using a cognitive model created by famous American researchers I. Anderson [39], B. Beyer [40], M. Hunter [34], which was based on the assumption that the process of cognition and, consequently, the process of personal and professional development of the subjects of the educational process should include the interaction of five criteria that determine the cognitive activity of the individual, namely, "Dimensions of Learning". This model, in turn, is based on a comprehensively studied and theoretically sound structure of criteria that reflect the development of student thinking ("Indicators of thinking"), which, according to the researcher R. J. Marzano [45] allow the teacher to improve the efficiency of the learning.

Based on the essential characteristics of the cognitive model, the most effective way to intensify cognitive activity are: fixing the attention of teachers and students in the learning process on interdisciplinary topics of the curriculum; assessment of knowledge with the help of students' ability to use this interdisciplinary knowledge, and in a theoretical perspective – the ability to complex reasoning, rather than to reproduce the acquired knowledge [44], [45], [54]. Thus, the use of a cognitive approach in the development of tolerance for uncertainty in the process of personal and professional development of future airmen on the basis of a reflective approach using the model "Training parameters" allowed us to obtain a number of positive results. At the same time, the five types of thinking, which, reflecting the features of the five "Learning Parameters", can be formed only as a result of the appropriate strategy of the educational process, non-linearly interacting, while:

- cognitive activity of the student in the learning process is accompanied by a set of changes that occur at the level of perception, which are ambiguously reflected in its further development, promoting or delaying further cognition (criterion one);
- the cognitive activity process is influenced by the degree to which the student uses the productive composition of the personal mind (criterion five);
- a student who has attitude that promote cognitive activity, and, accordingly, the peculiarities of perception, effectively using his mind, prone to the process of obtaining and integrating new knowledge (criterion two), i.e. the student successfully assimilates new knowledge, skills, abilities from previously formed;

- implemented at the subjective level, the process of interaction between old and new information over time turns into the development of new knowledge through cognitive activities that contribute to the expansion and improvement of current knowledge (criterion three);
- the end result of the educational process constructed at the formative stage of the educational process, i.e. the process of readiness for activity, is the conscious use of knowledge (criterion four), thus confirming that the student, receiving and integrating knowledge, uses it consciously, while expanding and improving new knowledge.

At the same time, considering the five learning criteria that form a holistic structure as those that can be useful in the design of curricula and assessment of knowledge, the authors have proven that the use of cognitive model “Learning Options” helps to create the necessary and sufficient conditions for the development of creative individuals who are constantly working to expand the range of their capabilities, taking full responsibility for the personal process of cognition and, in general, the student’s personal growth. The ultimate goal of the learning process is the development of an independent individual (subject) who can feel the need and is able to implement the ability to learn throughout life. However, this is possible if, when creating a model of student’s personal and professional growth, the conditions formulated by the authors will work effectively in the presence of feedback both rigid (cognitive) and flexible (strategic and conceptual, and operational and prognostic). Cognitive connection takes into account the absolute values of the differences between the actual results and the personal strategy (according to regulations). Strategic and conceptual connection tracks changes in the educational and information environment and makes conceptual adjustments to the purpose of education. Operational and prognostic communication takes into account the indicators at a particular time of training and allows to predict changes in the trajectory of the strategy of success [54], [55], [56], [57].

Thus, the development of tolerance for uncertainty in the process of personal and professional growth of students will be successful if during the educational process it will be possible to use project technologies in problem-oriented classes with the introduction of the principles of role perspective; apply self-organisation trainings in the process of organising both academic and extracurricular work to develop the skills of professional self-analysis.

## 5. CONCLUSIONS

The result of the experimental stage of the study, as the foundation of the personal and professional development of the student, confirmed the effectiveness of the model based on the reflective approach. The systemically important core of the study considered the goals and results implemented in the educational and informational environment of the National Aviation University with the help of appropriately constructed psychological and pedagogical conditions, which were implemented at each stage of professional training with the innovative educational technologies. The gradual formation of the personal and professional development of the subjects of the educational process, ensures the awareness by future specialists of the essence of the reflective approach and its significance in professional activity; introduction into the educational process of the problem – variative approach and subject–subject interaction of teachers and students in study groups; extracurricular, independent, and educational work to include students in reflective activity.

Considering that the most destructive and threatening factors for higher education are the lack of understanding of the need to reform the educational sphere before innovation processes; psychological support of the processes of personal and professional development

of students; innovative professional growth of the teaching staff and taking into account the individual component of the subjects of the educational process, the findings have proven that:

1. The existing traditional functional training of future aviation specialists forms only a contextual and algorithmic vision of contemporary educational environment, and not an informational and synergetic space that includes uncertain tasks, problems, hypotheses and variable axioms;

2. The professional development of the future aviation operator will be successful if the educational process is built in a systematic connection with personal development, taking into account the principles of uncertainty as the need to make decisions in the absence of information;

3. In a situation of uncertainty, a student may have two main types of emotional responses: positive (interest, curiosity) and negative (fear, anxiety), and, as a result, different strategies to overcome them: stimulating and blocking activity;

4. The concept of tolerance to uncertainty is formulated as an integrated personal quality, which determines the ability to respond positively to situations of uncertainty, to act in vaguely defined goals and objectives, incomplete availability of source information, the desire to overcome its inconsistency;

5. Taking into account the personal characteristics of a student, as system-forming conditions (criteria) for training optimisation, will contribute to the effective professional development of the student's personality in the implementation of the trajectory of successful lifelong learning;

6. The effectiveness of the formation of the professional subjectivity of the future specialist should be based on the plane of didactic modelling, which is able to ensure adequate assimilation of the modelled properties, connections and relations of information and didactic, cognitive and transformative objects of natural and sociocultural direction. The subject of activity will be the personal mental activity of the future specialist, forming knowledge as the orientation and beliefs of the individual, bringing skills and abilities to mastery and professional abilities;

7. Systematic monitoring and adjustment of the educational process on the basis of certain feedback allows to implement an individual-oriented approach to learning and the possibility of effective adjustment of the educational process in institutions of higher technical education

## REFERENCES

- [1] A. Mas-Colell, M. D. Whinston and J. R. Green, *Microeconomic theory*, Oxford University Press, 1995.
- [2] B. G. Ananiev, To the psychophysiology of student age: Modern psychological and pedagogical problems of higher education, *Leningrad*, vol. 2, pp. 5-8, 1974.
- [3] B. G. Ananiev, Student age psychology and knowledge assimilation, *Higher School Bulletin*, vol. 7, pp. 25-31, 1977.
- [4] M. E. Comadena, Brainstorming groups: ambiguity tolerance, communication, apprehension, task attraction, and individual productivity, *Small Group Behavior*, vol. 15, no. 2, pp. 251-264, 1984.
- [5] D. W. Tegano, Relationship of tolerance of ambiguity and playfulness to creativity, *Psychological Reports*, vol. 66, no. 3, pp. 1047-1056, 1990.
- [6] S. A. Eliseev, The main problems of the psychology of safe work, *Psychological Journal*, vol. 3, no. 5, pp. 97-105, 1982.
- [7] J. B. Campbell, Cognitive dissonance, in R. Corsini, A. Auerbach (Eds.), *Psychological Encyclopaedia*, Piter, 2006.
- [8] V. A. Goryachev, A new approach to the training of flight personnel abroad, *Flight Safety Issues: Monthly Abstract Collection*, vol. 10, pp. 3-22, 1990.
- [9] D. Bock, *Universities and the future of America*, Moscow State University Publishing House, 1993.
- [10] A. I. Averyanov, *Systemic knowledge of the world*, Politizdat, 1985.

- [11] M. S. Dmitrieva, *Management of the educational process in higher education*, Novosibirsk Electrotechnical Institute, 1971.
- [12] V. G. Kremen, Modern general civilized development trends and their impact on the education system, *Higher Education: Problems and Development Prospects*, vol. 17, no. 2, pp. 14–15, 1995.
- [13] Yu. P. Darymov, *On the choice of special situations for training aircraft crews on an integrated simulator*, in *Methods and means of professionally applied and psychophysiological training of flight and dispatch personnel of civil aviation*, OLAGA, pp. 31–33, 1979.
- [14] V. A. Bodrov, *Psychology and reliability: people in technology control systems*, Institute of Psychology RAS, 1998.
- [15] V. P. Buyanov, *Riskology (risk management)*, Ekzamen, 2003.
- [16] \* \* \* Global Aviation Safety Plan, 2020, Available at [https://www.caa.md/files/2015\\_12/768.pdf](https://www.caa.md/files/2015_12/768.pdf).
- [17] \* \* \* R. M. Jafarzade, Development of a method for training aircraft crew members based on hazard assessment of special situations, 1999, Available at <https://www.dissercat.com/content/razrabotka-metoda-podgotovki-chlenov-ekipazha-vozdushnogo-sudna-na-osnove-otsenki-opasnosti->.
- [18] R. S. Jensen, J. Andrien and R. Lawton, *Aeronautical decision making for instrumental pilots*, Federal Aviation Administration, 1987.
- [19] O. M. Reva, V. V. Kamishin and A. M. Panasyuk, The level of claims as a criterion for the attitude of future air traffic controllers to skipping classes, in *Quality of Technologies – Quality of Life: Proceedings of the III International Scientific-Practical Conference*, Kharkiv, 2011.
- [20] O. M. Reva, D. L. Marchenko and S. O. Dudnik, Theoretical principles of identifying students' attitudes to learning outcomes, *Pedagogy, Psychology and Sociology*, vol. 15, pp. 68–75, 2007.
- [21] A. Wenden and J. Rubin (Eds.), *Learner strategies in language learning*, Prentice-Hall, 1987.
- [22] S. J. Guastello, *Chaos, catastrophe and human affairs: applications of nonlinear dynamics to work, organizations and social evolution*, Lawrence Erlbaum, 1995.
- [23] \* \* \* Human Factors Module, 1999, Available at <https://rauterberg.employee.id.tue.nl/lecturenotes/HF99cost-report.pdf>.
- [24] O. M. Reva, O. V. Mikhailov and G. M. Seleznyov, Individual personality traits and safety of professional activity, *Emergency*, vol. 6, pp. 40–42, 2005.
- [25] V. V. Kamishin, Development of recommendations for individualization of professional training of aviation operators, *Modern Information and Innovative Technologies in Transport*, vol. 2, pp. 16–20, 2013.
- [26] S. D. Leichenko, A. V. Malishevsky and M. F. Mikhailik, *The human factor in aviation*, Saint Petersburg State University of Civil Aviation, 2006.
- [27] E. V. Luzik, Didactic modeling as a basis of the competence approach to optimization of process of training in VTNZ, in *Proceedings of the VIII International Conference “Quality Strategy in Industry and Education”*, Kyiv-Varna, 2012.
- [28] L. F. Lester and D. H. Bombaci, The relationship between personality and irrational judgment in civil pilots, *Human Factors*, vol. 26, pp. 565–572, 1984.
- [29] A. N. Reva, K. M. Tumyshev and A. A. Bekmukhambetov, *Human factor and flight safety*, KazSU, 2006.
- [30] Yu. K. Strelkov, *Engineering and professional psychology*, Academy, 2001.
- [31] F. H. Breshe, An instrumental design for aircrew judgment training, *Aviation Space & Environmental Medicine*, vol. 53, no 10, pp. 951–957, 1982.
- [32] M. A. Kotik, *Psychology and safety*, Valgus, 1989.
- [33] O. M. Reva, S. P. Borsuk and V. A. Shulgin, *Modern problems of the human factor in aviation*, UkrINTEL, 2018.
- [34] M. Hunter, *Mastery teaching*, TIP Publications, 1982.
- [35] O. M. Reva and V. P. Bulava, Rafts. “Emergency workers”: an analytical review of the causes of aviation events by the human factor, *Railway Transport of Ukraine*, vol. 6, pp. 37–41, 2008.
- [36] O. M. Reva, B. M. Mirzoev, P. S. Mukhtarov and Sh. Sh. Nasirov, The level of claims of air traffic controllers on workload indicators, *Aerospace Engineering and Technology*, vol. 8, no. 105, 273–281, 2013.
- [37] S. O. Dudnik, Through the Bologna process: theoretical bases of construction of estimation functions of usefulness of characteristics of educational process, *Problems of Education*, vol. 50, pp. 8–14, 2007.
- [38] U. Edward, *Decision-making: the human factor*, Mir, 1991.
- [39] J. Anderson, *Cognitive psychology and its implications*, W.H. Freeman and Company, 1990.
- [40] B. K. Beyer, *Developing a thinking skills program*, Allyn and Bacon, 1988.
- [41] J. Elliot, Developing hypotheses about classrooms from teachers' personal constructs, *Interchange*, vol. 7, pp. 1–22, 1977.
- [42] D. N. Perkins, *The mind's best work*, Harvard University Press, 1981.

- [43] S. N. Roscoe, *Man, as a precious resource: The enhancement of human effectiveness in air transport operations*, University of Illinois, Institute of Aviation, 1974.
- [44] G. Mandler, The nature of emotions, in J. Miller (Ed.), *States of mind*, Pantheon Books, 1983.
- [45] R. J. Marzano, D. J. Pickering, D. E. Arredondo, G. J. Blackburn, R. S. Brandt and C. A. Moffett, *Dimensions of learning teacher's manual*, Association for Supervision and Curriculum Development, 1992.
- [46] O. S. Povidaychyk and R. V. Kozubovsky, Formation of students' tolerance in the multicultural environment of higher education institution, *Scientific Bulletin of Mukachevo State University. Series "Pedagogy and Psychology"*, vol. **1**, no. 11, pp. 87–90, 2020.
- [47] O. M. Dobosh, Forming tolerance as a professionally important quality leaders of pre-school education institutions, *Scientific Bulletin of Mukachevo State University. Series "Pedagogy and Psychology"*, vol. **1**, no. 11, pp. 128–132, 2020.
- [48] R. A. Abramov and M. S. Sokolov, Features of corruption in the educational sphere in the context of globalization of educational space, *Journal of Legal, Ethical and Regulatory Issues*, vol. **20**, Special issue 1, pp. 1–10, 2017.
- [49] N. V. Kartushina, Application of total quality management mechanism for students of higher education institutions, *Asia Life Sciences*, vol. **22**, no. 2, pp. 273–286, 2020.
- [50] R. R. Anamova, L. V. Bykov and D. A. Kozorez, Algorithm for designing professional retraining programs based on a competency approach, *Education Sciences*, vol. **10**, no. 8, 1–9, 2020.
- [51] M. Kuprikov and L. N. Rabinskiy, Vertical take-off and landing aircrafts: Myth or reality of modern aviation, *Journal of Mechanical Engineering Research and Developments*, vol. **41**, no. 4, pp. 46–52, 2018.
- [52] I. H. Lebid, Transportation technology bachelors' professional training in Ukraine: peculiarities and development trends, *Scientific Bulletin of Mukachevo State University. Series "Pedagogy and Psychology"*, vol. **1**, no. 11, pp. 84–87, 2020.
- [53] R. R. Anamova, S. A. Leonova, L. G. Nartova and V. P. Tereshchenko, Digital spatial models in technology as a development tool of the intellectual creative aspect within education. *TEM Journal*, vol. **9**, no. 3, pp. 1186–1193, 2020.
- [54] S. Kerman, T. Kimball and M. Martin, *Teacher expectation and student achievement: coordinator's manual*, Phi Delta Kappa, 1980.
- [55] O. V. Prokopenko, Consumer choice types in marketing of ecological innovations, *Actual Problems of Economics*, vol. **116**, no. 2, pp. 109–116, 2011.
- [56] N. V. Solovei and O. V. Kostyunik, Analysis of financial stability factors of aviation enterprises, *Scientific Bulletin of Mukachevo State University. Series "Economy"*, vol. **2**, no. 10, pp. 140–143, 2018.
- [57] S. Santostefano, Cognitive controls, metaphors and contexts. An approach to cognition and emotion, in D.J. Bearson (Ed.), *Developmental Perspectives*, Lawrence Erlbaum, 1986.