

DOI: 10.15804/tner.2024.75.1.14

Yurii Pelekh

University of Rzeszow, Poland

Ganna Shlikhta

Rivne State University of the Humanities, Ukraine

21st Century Skills and Individual Basic Values of the Future IT Specialist: Education Perspective

Abstract

Given the reliance of the contemporary IT professional training process on a predetermined scenario for success outlined in educational programs and confined within local needs our research aimed to identify and examine effective ways of integrating spiritual and professional development for future specialists in the field of digital (IT) technologies. Our assumption was that the development of core values as a spiritual component of IT specialists influences the effectiveness of acquiring 21st century skills and shapes their professional competence. A correlational study was conducted to explore the relationship between the level of formation of core values in future IT specialists and the level of 21st century skills in these individuals. The research strategy was based on the application of distinct methods (Schwartz, S. H. (1992), Hixson, 2012, mathematical statistical methods – Kendall's correlation analysis) to test the effectiveness of the author's model. Its conceptual idea is to confirm the hypothesis that higher levels of 21st century skills correlate with higher levels of core values in future IT specialists. The results of the tasks revealed correlations between higher levels of 21st century skills and the core values of future IT specialists. This allowed confirming the leading idea of the research: Ukrainian students in IT specialties demonstrate the ability to acquire 21st century skills associated with values that support a "positive" vector in the functioning of an individual (benevolence, conformity, security, traditions, universalism, stimulation, and independence).

Keywords: 21st century skills, correlation, competence, IT specialists, values

Introduction

Nowadays 21st century skills are an important component of the competence for a contemporary professional. In times of rapid technological change and digitalization, coupled with the integration of IT professionals into every sector, 21st century skills are a crucial aspect of professional training for such experts (Cruz et al., 2021). These skills aid in successfully navigating a rapidly changing technological environment, fostering the development of new ideas, creating innovative products, and effectively implementing technological solutions. The acquisition of 21st century skills by IT professionals in higher education institutions enables the preparation of competent, adaptable, and holistic professionals capable of implementing innovations, tackling complex tasks, and working in the modern conditions of technological development (Van Laar et al., 2020).

The 21st century skills are becoming essential for the development of the IT industry and for achieving success (Kim et al, 2019). Therefore, the overall approach to the professional training of future IT professionals involves integrating 21st century skills into all aspects of IT education.

The developed values and meaning system is considered to be one of the foundations of the proficiency in 21st century skills (Lambrechts, 2019). The foundational values that a student brings to higher education play a crucial role in shaping skills and readiness for contemporary life. This idea underscores the importance of the connection between personal values and the learning process. According to the study (Kennedy et al., 2022) foundational values can serve as the basis for determining which skills a student aims to develop during their educational journey.

Theoretical Background

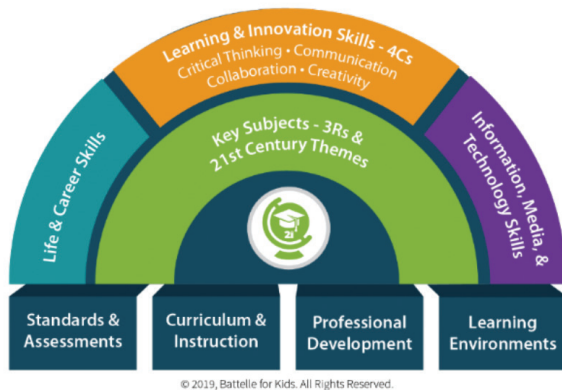
In times of rapid technological advancement, information technologies evolve swiftly, and technical knowledge becomes outdated quickly. The IT industry itself imposes high demands on professionals (Cruz, 2021), and today's IT must be capable of critical thinking, actively seeking and solving problems (Gonzalez & Ramírez-Montoya, 2022).

Higher education institutions play a crucial role in shaping the skills necessary for successful adaptation to the modern challenges. Contemporary higher education programs are oriented towards developing flexibility and adaptability while providing opportunities to enhance creative thinking and problem-solving skills. Thus, university education provides students with professional ex-

pertise and prepares them for effective participation in the modern, rapidly changing society (Saavedra & Opfer, 2012).

The primary document that defines and integrates the concept of “21st century skills” into the educational process was developed by the organization – Partnership for 21st Century Skills (P21, Partnership for 21st Century Schools, 2019). P21 has developed a framework outlining a set of skills necessary for students to thrive in the modern world (Figure 1).

Figure 1. 21st Century Skills Framework



Source: Partnership for 21st Century Schools, 2019

The P21 framework is considered a unified template for conceptualizing 21st century skills. The described framework establishes a connection between 21st century skills and the values necessary for survival. It is values that are the foundation of 21st century skills. Based on this template, Ali Simsek’s research identified 11 key values that surround and interconnect with these skills. Some of these values (justice, friendship, honesty, love, respect, patriotism, and willingness to help) have already been incorporated into the current educational curriculum in Turkey, while others (morality, conscience, manners, and thrift) were added to the research model (Simsek et al., 2023).

We considered the conceptualization of 21st century skills by The William and Flora Hewlett Foundation (2010) and the structure of 21st century skills as described in Hixson’s research (Hixton, 2012) and based on the international classification of Innovative Teaching and Learning study (Shear et al., 2010): critical thinking, creativity and innovative skills, self-direction, communication, collaboration, global connections, local connections, using technology as a tool for learning.

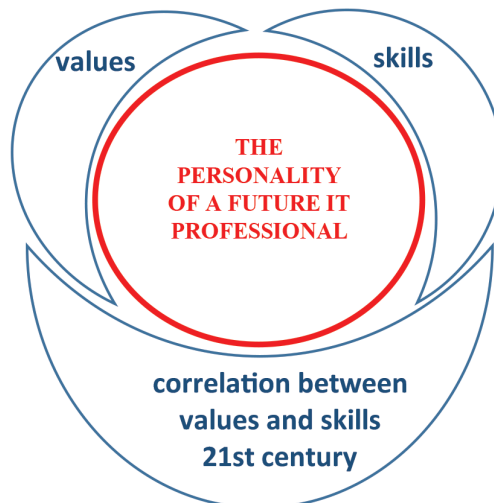
It is useful to study the IEEE Code of Ethics (IEEE Code, 2020). Some of the key principles outlined in this regulatory document are also included in the structure of 21st century skills obtained in Hixson's research, namely: honesty, fairness, leadership, integrity, empathy, respect, responsibility, loyalty, compliance with the law, transparency, and environmental care. This ethical code helps ensure responsible, ethical conduct of professionals in the field of technology, taking into account the impact of their work on society, the environment, and other individuals.

The 21st century skills acquired by IT professionals encompass a broad spectrum of competencies that will help them become effective in the modern world of technology. Andrade's research (2016) suggests that the learning outcomes of students in higher education institutions, such as communication, problem-solving, critical thinking, and innovation, should be widely incorporated into the educational program structure to ensure the quality preparation of professionals and the activation of 21st century skills (Andrade, 2016).

If the students' values and goals harmoniously align with 21st century skills it creates a foundation for success. The values and meaning system development so as 21st century skills, should be a priority in modern education and be included in the term "competence".

By examining and identifying basic values and their levels of formation, studying their alignment with 21st century skills, a model of the *value-deontological structure of their personality* was obtained, which looks like this (fig.1)

Figure 2. Study model



According to the model outlined above, the research algorithm will take the form:

- Phase 1. Determining the level of basic values in students – future IT professionals using the Schwartz methodology.
- Phase 2. Assessing the level of acquisition of 21st century skills in the same group of students.
- Phase 3. Identifying the correlation between specific basic values and 21st century skills.

Research Hypothesis

The research hypothesis is that higher-level 21st century skills correlate with higher levels of formation of basic values in future IT professionals.

More specifically, the research aims to answer the following questions:

1. What is the level of basic values among students – future IT professionals (Schwartz methodology)?
2. What is the level of 21st century skills proficiency among the same students – future IT professionals (Hixson's methodology, 2012)?
3. Is there a correlation between 21st century skills and basic values, taking into account the levels of formation, and which values correlate with 21st century skills?

Research Methodology

Concepts and Processes

Using a mixed research method, it was divided into 2 stages: quantitative data collection and in-depth qualitative data collection.

At the quantitative stage students were identified and questionnaires was developed and administered to the specified students.

Samples

The total of 513 second and third-year students in the bachelor's degree programs of specialties Software Engineering, Computer Science, Professional Education (Digital Technologies) from the following higher education institutions: Lviv Polytechnic National University, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", and Rivne State University of the Humanities. were included in the sample. To demonstrate statistically significant differences among our students – future IT professionals, based on their levels of basic values, and to conduct a comparison at a confidence level

of 95%, we calculated that we need responses from a total of 347 students using MacCorr Research Solutions Online Sample Size Calculator (MacCorr, 2023).

The Research Tools

To conduct in-depth qualitative data collection two experimental instruments were developed:

- 1) To assess the level of basic values among higher education participants – future IT professionals at the university we used Schwartz’s methodology (Schwartz, 1992). Participants assessed themselves using 10 types of values (conformity, tradition, benevolence, universalism, self-direction, stimulation, hedonism, achievement, power, and security) and determined the extent to which these descriptions reflected their personal values. Measurement was carried out and a system of levels of basic values for participants in the educational process at the university was developed.
- 2) To assess the level of 21st century skills proficiency among future IT professionals in such a sample a questionnaire with 48 questions was used. The survey was conducted using Google Forms, in accordance with the developed methodology for diagnosing the current level of 21st century skills (Hixson, 2012): critical thinking, collaboration, communication, creative and innovative skills, responsibility, global connections, local connections, and technology use (Hixson, 2012). The Likert scale for determining the level of 21st century skills proficiency among students was adapted from the research of Casner-Lotto and Benner (2006).

The survey link was sent to participants via email and on social media. Respondents participated in the survey voluntarily. The research adhered to the principles of complete confidentiality, guarantees of anonymity, and security regarding all personal data, conditions, and situations. The obtained data was used exclusively for academic and research purposes.

Research results

It was found out that values of “universalism” and “benevolence” obtained the highest level of formation (4.35 and 4.0 points, respectively). It means that universalism promotes openness to various ideas and perspectives while benevolence suggests that the future IT professional is socially aware and attentive to the needs and emotions of others which is crucial for personal growth and professional activities of a future IT professional despite being in a country dealing with russian aggression.

To address the research question regarding the connection between the level of development of the value-meaning sphere and the current level of proficiency in 21st century skills among future IT professionals we processed the research results using correlation analysis by Kendall method in the IBM SPSS Statistics 28 software package (Table 1).

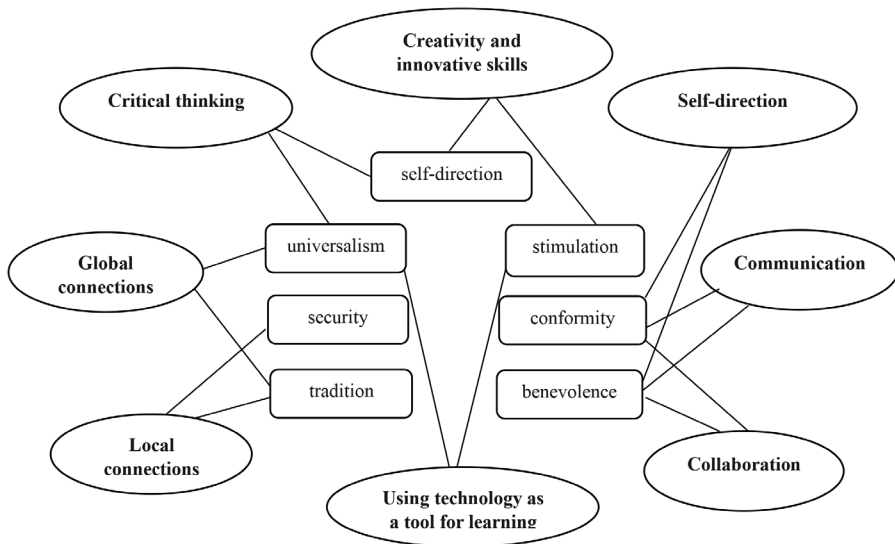
Table 1. Correlation relationships between 21st century skills and basic values

21 st century skills	Correlated values	Kendall rank correlation coefficient	Level, significance
Critical thinking	universalism	$\tau=0,361$	$p<0,0001$
	self-direction	$\tau=0,423$	$p<0,00001$
Creativity and innovative skills	self-direction	$\tau=0,395$	$p<0,0001$
	stimulation	$\tau=0,284$	$p<0,001$
Self-direction	conformity	$\tau=0,344$	$p<0,0001$
	benevolence	$\tau=0,358$	$p<0,0001$
Communication	conformity	$\tau=0,544$	$p<0,000001$
	benevolence	$\tau=0,377$	$p<0,0001$
Collaboration	conformity	$\tau=0,261$	$p<0,001$
	benevolence	$\tau=0,301$	$p<0,0001$
Global connections	universalism	$\tau=0,429$	$p<0,00001$
	tradition	$\tau=0,327$	$p<0,0001$
Local connections	security	$\tau=0,735$	$p<0,000001$
	tradition	$\tau=0,312$	$p<0,0001$
Using technology as a tool for learning	stimulation	$\tau=0,390$	$p<0,0001$
	universalism	$\tau=0,242$	$p<0,001$

Note: the table contains a statistically significant result (n=347).

Let's depict these correlation relationships as a correlation plot (Fig.3). The inner circle represents basic values while the outer circle represents 21st century skills.

Figure 3. The correlation plot illustrates the connections between 21st century skills and basic values



Note: this line indicates statistically significant results.

As follows from the data a number of positive correlations were found between the level of formation of basic values and the skills of the 21st century.

Higher-level critical thinking has connections with universalism and self-direction. This means that students' ability to question and assess information, the ability to seek alternatives, solve problems with no clear answers, is closely associated with self-reliance and the ability to maintain critical distance from oneself, assimilate the values of other cultures and worldviews, and appreciate and tolerate existing differences.

Responsibility shows a positive correlation with conformity and benevolence. So, the inclination to take responsibility is associated with loyalty to the system in which students are involved. It is the inclination to adhere to norms and rules established by the educational process in higher education, need for belonging to scientific community, and awareness of the necessity to interact with other groups and professionals.

Global connections show positive correlations with universalism and tradition. These connections are ambiguous. On the one hand, this may signify a global orientation, a commitment to the well-being of the entire world, and readiness for broad interaction. At the same time it indicates a tendency to

preserve one's own traditions and respect for one's culture. The current situation in Ukraine indeed reflects the youth's effort to integrate into a new life context while preserving their authenticity to the world. On the other hand, such a combination can lead to internal conflict because global integration may result in the loss of national or personal uniqueness, and assimilation becomes a process of dissolving boundaries. So, we see a simultaneous combination of values aimed at globalization and detachment from the world in an attempt to preserve own culture and traditions.

Communication skills and collaboration show connection with conformity and benevolence. So, it reveals this process through certain orientations of the personality toward loyalty and tolerance towards others, readiness for compromise and the ability to consider the others' position. Collaboration involves orientations towards openness to others, understanding the contribution of each to the collective work, friendship or mutually beneficial interaction.

Creative and innovative skills (of average development) demonstrate connections with independence and stimulation (also of average development). The need for stimulation implies a desire for novelty, diversity and deep experiences to maintain an optimal level of activity, and the development of creative and innovative skills as the ability to generate and improve solutions to problems or tasks and generate new unconventional ways is entirely based on a developed need for stimulation.

Local connections is strongly correlated with security reflecting the current situation in Ukraine, which is globally connected to the loss of security. Therefore, we observe an inflation in the significance of this value, especially for ensuring local connections within communities in the conditions of war. The connection with the value of traditions means that this level of establishing connections with society (at the local regional level) is associated with the preservation of culture, language, religion etc.

The use of technology for future IT professionals is a skill that falls within the realm of subject-specific competencies and it is therefore understandable that there is a connection with the need for new knowledge, development (stimulation) and a tendency to assimilate global experience and technologies borrowed from other countries (universalism).

It should be noted that such basic values as power, achievement and hedonism (low level of development) did not show any significant correlation with the values of the 21st century. A possible explanation could also be the crisis situation in Ukraine where the needs for comfort and pleasures are extremely unmet, as well as the need for achievement, so they fall out of the current priorities of Ukrainian students. The need for power may be blocked due to

the longstanding experience of ineffective governance, leading to decreased significance of this value and the absence of its regulatory role in education. Moreover the nature of the IT profession does not involve an increase in social status through gaining power and achieving authoritative positions.

Discussion

As we can see the values of benevolence and conformity are the most loaded in terms of the number of correlation links – of higher formation levels, according to the research. According to the circle of S. Schwartz (Schwartz & Bilsky, 1994), they belong to two larger blocks: conservation and self-enhancement. This result serves as a guideline for understanding what can ensure the formation and functioning of skills such as responsibility, collaboration, and communication.

The obtained results about values creating the self-enhancement block (achievement, hedonism, and power) correspond to research on the values of students involved in volunteer activities in Ukraine in the context of war (Podolianchuk, 2021), which indicates a low significance of power values. However, these results somewhat differ from the original study by N. Hixson (2012), where it is stated that teachers are most oriented towards students demonstrating achievement values and competitiveness.

Ukrainian researchers who study the value orientations of student youth (Kurova, 2021) also indicates the dominance of values related to material success, personal growth, and self-assertion among students.

The organization of the identified connections of basic values corresponds to two dimensions outlined by S. Schwartz: openness to change/conservatism and self-enhancement/self-transcendence. More actively engaged in connections with 21st century skills is the self-transcendence pole, formed by the values of universalism and benevolence (higher level of formation). We also observe a certain internal conflict between the poles of openness to change (average level of formation – values of self-direction and stimulation) and conservatism (average level of formation – values of security, conformity, and tradition). However, each pole supports the acquisition of the corresponding 21st century skills.

The overall conclusion we reach is that Ukrainian IT students demonstrate the ability to acquire 21st century skills associated with values that support a “positive” vector in personal functioning (benevolence, conformity, security, tradition, universalism, stimulation, and self-direction). These are values with higher and moderate levels of formation.

Conclusion and Recommendations

It can be concluded that there is a connection between the levels of 21st century skills proficiency and the levels of basic values of students – future professionals in the field of information technology. The basic values of high-level students correlate with 21st century skills of high formation level as well. The positive correlation between fundamental values such as “benevolence” and “universalism” with 21st century skills like “critical thinking”, “responsibility”, and “collaboration” allows for optimism regarding the education of youth and the motivation of students, despite the challenging conditions faced by the current generation during Russia’s military aggression.

Referring to this research and the collected data, one can conclude that identifying the levels of development of fundamental values can impact the strengthening of the development of the certain 21st century skills during the professional training of future information technology professionals in higher education institutions. Therefore, it is necessary to improve the intervention system by educators and psychologists in shaping the 21st century skills in future IT professionals.

Our research inquiry does not conclude with the results of this academic work. In subsequent research, we will focus on testing the hypothesis with a cohort of IT professionals enrolled in master’s programs.

References:

- Andrade, M. S. (2016). Curricular elements for learner success—21st Century Skills. *Journal of Education and Training Studies*, 4(8), 143–149. <http://dx.doi.org/10.11114/jets.v4i8.1743>
- Casner-Lotto, J. & Benner, M. (2006). Are they really ready for work? Employers’ perspectives on the basic knowledge and applied skills of new entrants into the 21st century workforce. New York: The Conference Board, Inc., the Partnership for 21st Century Skills, Corporate Voices for Working Families, & the Society for Human Resource Management. Retrieved from <https://files.eric.ed.gov/fulltext/ED519465.pdf>
- Cruz, G., Payan-Carreira, R., Dominguez, C., Silva, H., & Morais, F. (2021). What critical thinking skills and dispositions do new graduates need for professional life? Views from Portuguese employers in different fields. *Higher Education Research & Development*, 40(4), 721–737. <https://doi.org/10.1080/07294360.2020.1785401>
- Dida, H. (2023). Profesiyniyi samorozvytok osobystosti studenta medychnoho koledzhu: motyvatsiinotsiyniyi komponent [Professional Self-Development of the Personal-

- ity of a Medical College Student: A Motivation-Value Component]. *Education. Innovation. Practice*, 11(5), 13–17. <https://doi.org/10.31110/2616-650X-vol11i5-002> [in Ukrainian]
- González-Pérez, L. I. & Ramírez-Montoya, M. S. (2022). Components of Education 4.0 in 21st Century Skills Frameworks: Systematic Review. *Sustainability*, 14(3), 1493. <https://doi.org/10.3390/su14031493>
- Hixson, N. K., Ravitz, J. & Whisman, A. (2012). Extended professional development in project-based learning: Impacts on 21st century skills teaching and student achievement. West Virginia Department of Education. Retrieved from <https://files.eric.ed.gov/fulltext/ED565466.pdf>
- IEEE Code of Ethics (2020). Retrieved from <https://www.ieee.org/about/corporate/governance/p7-8.html>
- Kennedy, K.J., Pavlova, M. & Lee, J.C.-K. (Eds.). (2022). *Soft Skills and Hard Values: Meeting Education's 21st Century Challenges* (1st ed.). Routledge. <https://doi.org/10.4324/9781003219415>
- Kim, S., Raza, M. & Seidman, E. (2019). Improving 21st-century teaching skills: The key to effective 21st-century learners. *Research in Comparative and International Education*, 14(1), 99-117. <https://doi.org/10.1177/1745499919829214>
- Kurova, A. (2022). Spetsyfika struktury tsinnisnykh oriientsii osobystosti v umovakh nevyznachenosti [Specificity of Personality Value Orientation Structure in Conditions of Uncertainty]. *Scientific Journal of the National Pedagogical Dragomanov University, Series 12. Psychological sciences*, 18(63), 24-31. [https://doi.org/10.31392/NPU-nc.series12.2021.18\(63\).03](https://doi.org/10.31392/NPU-nc.series12.2021.18(63).03) [in Ukrainian].
- Lambrechts, W. (2019). 21st century skills, individual competences, personal capabilities and mind-sets related to sustainability: a management and education perspective. *The Central European Review of Economics and Management*, 3(3), 7–17. <https://doi.org/10.29015/cerem.855>
- MacCorr Research Solutions Online Sample Size Calculator. Retrieved from <http://www.macorr.com/sample-size-calculator.htm>
- Partnership for 21st Century Schools. (n.d.) FAQs. Washington DC: Author. Retrieved from <http://www.p21.org/overview/p21-faq>.
- Podolianchuk, D. (2021). The research of the cognitive component of value orientations of volunteering students. *Psychological Prospects Journal*, 37, 185–201. <https://doi.org/10.29038/2227-1376-2021-37-185-201> [in Ukrainian].
- Rieckmann, Marco. (2011). Future-oriented higher education: Which key competencies should be fostered through university teaching and learning? *Futures*, 44, 127-135. <https://doi.org/10.1016/j.futures.2011.09.005>
- Saavedra, Anna & Opfer, V Darleen. (2012). Learning 21st-Century Skills Requires 21st-Century Teaching. *The Phi Delta Kappan*, 94, 8-13. <https://doi.org/10.2307/41763587>.
- Schwartz, S. H. (1992). Universals in the content and structure of values: Theory and empirical tests in 20 cultural groups. In M. Zanna (Ed.). *Advances in experimental social psychology*, 25, 1-65. [https://doi.org/10.1016/S00652601\(08\)60281-6](https://doi.org/10.1016/S00652601(08)60281-6).

- Schwartz, S. H. & Bilsky, W. (1994). Values and personality. *European Journal of Personality*, 8, 163–181.
- Shear, L., Novais, G., Means, B., Gallagher, L. & Langworthy, M. (2010). *ITL Research Design*. Menlo Park, CA: SRI International. Retrieved from https://www.sri.com/wp-content/uploads/2021/12/itl_research_design_15_nov_2010.pdf
- The William and Flora Hewlett Foundation (2010). *Education program strategic plan*. Menlo Park, CA: Author. Retrieved from http://www.hewlett.org/uploads/documents/Education_Strategic_Plan_201.pdf
- Türel, Yalın & Simsek, Ali & Vautier, Cemre & Simsek, Emine & Kızıltepe, Firat. (2023). *A Research Report on 21st Century Skills and Values*. <https://doi.org/10.13140/RG.2.2.14889.16487>.
- Van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M. & de Haan, J. (2020). *Determinants of 21st-Century Skills and 21st-Century Digital Skills for Workers: A Systematic Literature Review*. *SAGE Open*, 10(1). <https://doi.org/10.1177/2158244019900176>

AUTHORS

YURII PELEKH

University of Rzeszow, Poland
E-mail: ypelekh@ur.edu.pl

GANNA SHLIKHTA

Rivne State University of the Humanities, Ukraine
E-mail: hanna.shlikhta@rshu.edu.ua