International Journal of Pedagogics

VOLUME Vol.05 Issue06 2025
PAGE NO. 278-280
DOI 10.37547/ijp/Volume05Issue06-75

The Importance of Developing Practical Competencies in The Training of Engineer-Metrologists Through Metasubject Maps

Yokuthon Rukhiddinovna Najmiddinova

Associate Professor, Department of Metrology and Standardization, Namangan State Technical University, Uzbekistan

Received: 25 April 2025; **Accepted:** 21 May 2025; **Published:** 23 June 2025

Abstract: This article presents the scientific and methodological foundations of using metasubject maps in the training process of engineer-metrologists to develop practical competencies. It analyzes how an integrative approach helps systematize knowledge, skills, and competencies related to professional activities. The metasubject map ensures cognitive and interdisciplinary connections, enabling the preparation of competitive specialists capable of operating in real production environments.

Keywords: Metrology education, practical competencies, metasubject approach, cognitive map, interdisciplinary integration.

Introduction: 21st century from engineers - metrologists demand to be done the most important from skills one - this interdisciplinary, practical and innovative activity harmonized in case independent opinion management, analysis to do and decision reception to do is the ability. Metrologist specialists and this to skills further more need because they notice them accuracy, standards, quality and security with related decisions reception what they do need. This bois , metasubject competencies and their visualized shape - map (cognitive or clustered) expert in preparation important importance profession will do .

Current global competition and in the era of industry 4.0 engineer - metrologists activity not only high accuracy and to standards based maybe analysis, decision reception make, innovative approach and interdisciplinary reflection management like high metacognitive competence both demand This is competence in formation practice with related knowledge deep mastery and them various sciences at the intersection coordination separately to the point owner. This because of education in the process metasubject approach current verb and competencies visual in a way reflection guide cognitive maps application modern to the requirements suitable coming innovative solution is considered.

Metasubject approach education consistent, cross-industry and complicated cognitive activities through organization to do directed is, it is future in specialists knowledge various sciences in the context of critical analysis to do, to repeat application and new condition - conditions adaptation ability develops. Metrology in the field this is especially the measure processes, calibration, international standards with at work own expression finds In this regard, the article aims to analyze the theoretical foundations of the metasubject map concept, its advantages in practice, and its role in the formation of practical competencies in future specialists.

What is a metasubject map? and what is it with important? The idea of the metasubject approach began to take shape in Soviet pedagogy and cognitive psychology in the second half of the 20th century, particularly in the 1970s and 1980s. This approach initially integrative education in the concept, that is various sciences between mutual dependency open in giving applied. Later on this approach cognitive pedagogy, active -constructive education theory active education methods and in education neuroscientific basics wide developed in time further complete taking shape went.

The concept of meta-subject mapping has been used in education since the 2000s , especially in Russia and Finland. in systems of education interdisciplinary and practical integration for visual tool as current Today 's on the day metasubject maps are available worldwide

in STEM, CDIO and Like Outcome -Based Education (OBE). in approaches main education from the means one as is being used.

What for " metasubject " called? The term "metasubject" refers to universal knowledge and competences that transcend different disciplines in the educational process, i.e. generalize interdisciplinary.

This concept from the words "meta-" (above, behind) and "subject" (science). Organization found So, metasubject map - this not a separate science, but various sciences at the intersection formable general habit and knowledge visual in the form of descriptive tool is considered.

Metasubject approach knowledge within the map only within science not, but interdisciplinary dependency and in practice the application shows. It is cognitive processes, independent thinking, analysis do, communication, digital competencies universal skills such as reflection will be delivered. Therefore this visual tool as " metasubject ". is called - because it is something not to one subject, but to one how many fanning general to the values service does.

A metaobject is a map in education interdisciplinary integration providing, cognitive processes visualizer and practical to work directed education from the means one is considered It has the knowledge and skills of a metrologist engineer and experience cognitive in a way systematized and sciences at the intersection into existence universal competences exactly is expressed.

Metasubject map is not only theoretical concepts Harmonization, but also reflexive and critical to think development, knowledge new in context application is complicated issues systemic analysis to do ability forms. Also this maps education in the content cognitive download to optimization and metrologist engineer personal to study strategies to develop service does.

Modern neuropedagogy and cognitive psychology perspective from the point of view metasubject maps metrologist engineer " worker" memory " (working memory) effectively management, knowledge between dependency to show and metacognitive activity in activation is an important mechanism.

" Worker" memory ” (working memory) - this human brain information short term during to keep and then one of time in itself logical , cognitive operations to perform is the ability . In fields built on precision and standards, such as metrology, this approach helps prepare future professionals not only to acquire information, but also to apply it in manufacturing practice.

The metasubject map is a cognitive model that visually reflects the universal practical competencies that are formed through various disciplines (metrology, standardization, physics, mechanics, mathematics, information technologies) in the course of educational activities. It reflects the interrelation of practical skills, information sources, technical tools and analytical processes.

Metasubject of the map the advantages are as follows:

- ❖ Competencies cognitive in terms of harmonization;
- ❖ Interfaculty dependency integration;
- ❖ Education the process individualization;
- ❖ Problematic in situations fast decision reception to do ability development;
- ❖ Practical examples and real projects through knowledge strengthening

It is important to use the following methods comprehensively for the effective formation of practical competencies in engineer-metrologist education. Accordingly, we will consider the methods of formation of practical competences:

1. Case-study method: Through analysis and solution-finding activities based on real-life metrological problems (e.g., identifying measurement errors, failures in the calibration process), future specialists learn to think critically and make independent decisions.

2. To the project based Project-based learning. Future specialists develop and present projects on measurement systems, standardization, or quality assessment based on real production needs.

3. STEM integration. Combining mathematics, physics, information technology, and engineering disciplines based on a meta-subject approach forms the complex and systematic thinking of future specialists.

4. Intellect - cards and cognitive maps Structure . Future professionals analyze the interrelationships of the competencies they are learning by graphically representing them. This helps them structure, generalize, and adapt knowledge to new situations.

5. This is a joke. modeling and roller Games. In virtual or near-practical situations organized according to standards, future specialists practice decision-making and problem-solving based on established roles.

6. Digital simulations. Future specialists develop practical skills by simulating assessment processes in a virtual environment based on standards such as ISO 9001 and ISO/IEC 17025. These methods, combined with a meta-subject approach, allow for a more

practical, analytical, and innovative approach to the learning process.

In order to introduce cognitive maps based on the meta-subject approach and form practical competencies, an experimental study was organized among 2nd-3rd year future specialists studying metrology in the 2021-2024 academic year. Case studies, cognitive maps, STEM integration, and simulation methods were gradually introduced into the educational process.

The results show that cognitive maps and practical exercises based on the metasubject approach not only consolidate knowledge in future specialists, but also form the ability to understand interdisciplinary connections, work independently with standards, and conduct critical analysis. The systematic introduction of such approaches into metrology education will significantly increase the professional training of specialists.

Based on the above analysis, it can be concluded that the metasubject approach and cognitive maps are an important mechanism for the effective formation of practical competencies in the education of metrology and standardization. It not only deepens the theoretical knowledge of future specialists, but also develops their ability to apply them in practical situations.

Through this approach: interdisciplinarity is strengthened; educational content adapts to real practice; future specialists develop critical, analytical and reflexive thinking; personnel ready for competitive, standardization and quality assurance fields will be trained. The practical significance of these results is that the integration of such an approach into educational programs will serve to train metrologists with an innovative mindset in line with industry requirements.

REFERENCES

Ўзбекистон Республикаси Вазирлар Маҳкамасининг 2020 йил 14 декабрдаги 781-сон қарори.

Нажмиддинова Ё.Р., Давронова М.У. Бўлажак муҳандис-техникларда касбий тарбия муаммоси. – “Техника ва технологик фанлар соҳаларининг инновацион масалалари” мавзусидаги халқаро илмий-техник анжумани. ТДТУТФ -2020 йил. 24-бет.

Najmiddinova Yo. R., Inamov D. D., Davronova M. U., Inamiddinova D. K. METHODOLOGY OF THE FORMATION OF GENERAL VOCATIONALTRAINING IN STUDENTS OF HIGHER EDUCATIONAL INSTITUTIONS ON THE BASIS OF COMPETENCY APPROACH // PALARCH’S JOURNAL OF ARCHAEOLOGY OF EGYPT / EGYPTOLOGY, PJAEE, 17 (6) (2020). – 3663-3679 page. http://www.palarch.nl/index.php/jae/article/view/14 82

Najmiddinova Yo. R. Conditions of Forming Professional Abilities and Skills on Competence Approach among Colleges Students // Eastern European Scientific Journal. - Germany, 2018. -№4. - P.196-199.

Najmiddinova Yo. R., Ibragimov R. Sh., Yigitaliyev J. A. THE CONCEPT OF ICT COMPETENCE OF PERSONNEL. THE IMPORTANCE OF HAVING ICT COMPLEMENT AND INFORMATION CULTURE // INTERNATIONAL ENGINEERING JOURNAL FOR RESEARCH AND DEVELOPMENT - Vol. 5 Issue 2, March 2020... http://www.iejrd.com

Нажмиддинова Ё.Р. Коллеж ўқувчиларида касбий кўникмаларни ривожлантириш методикаси. Монография. –Тошкент, “Sano-standart”, 2018. - Б.128.

Нажмиддинова Ё.Р. Метапредметный подход в высшем образовании-как фактор повышения качества подготовки специалистов. // НамДУ илмий ахборотномаси. – Наманган. 2020. -№12. -Б. 477-481.