The influence of the knowledge lifecycle model on the trends in the training of technical specialists

Y Y Savchenko, O G Goleva, I A Korchagina and A V Ovsyannikova
Altai state University, Lenina str, 61, Barnaul, 656049, Russia

E-mail: kolmakova@rb.asu.ru

Abstract. The article is devoted to identifying the main directions of influence of knowledge lifecycle models on the training of technical specialists. The authors identify one of the primary problems of world education, which is the obsolescence of knowledge. Today, the pace of technological change and the introduction of innovations have a lifecycle of knowledge. The article proposes to present the knowledge lifecycle in the form of a forced model. The article suggests orientation to a spiral model of the knowledge lifecycle. Particular attention is paid to the initial stages of training and the formation of a basic set of foresight competencies. The paper considers the cycle of the level of competence of a student in a technical specialty, with the educational process being oriented towards a spiral model of the knowledge lifecycle. The article discusses the experience of countries occupying leading positions in the development of educational programs for the training of specialist engineers. The authors of the article determined that the orientation in the development of educational programs for the training of technical specialists, including engineers, towards a spiral model of the knowledge lifecycle will allow developing a model of advanced learning.

1. Introduction
The development of the country's industry, and, first of all, engineering, largely determines the potential of its economy. It is precisely by the level of development of mechanical engineering that the gap between the leading countries of the world economy and the countries of the second and third tier is most clearly visible.

The educational process today should be based on advanced learning technology. One of the primary problems of world education is the obsolescence of knowledge. Obviously, this is caused by a constant increase in the volume of information.

According to studies conducted by McKinsey, an international consulting company in the global labor market, more than 50% of the workforce may lose their jobs due to the introduction of innovative systems and automation tools [1].

The survey results presented at the World Economic Forum suggest that by 2022 42% of the basic professional skills that are in demand on the labor market today will undergo deformation [2].

This indicates that graduates of educational organizations may be unclaimed in the labor market, since the competencies that they possess may already be obsolete. Under these conditions, constant adaptation of the educational processes to the requirements of the time is required, moreover, their advance.
2. Research methodology

In a fairly large number of publications by domestic and foreign scientists, the issues of the formation and development of professional competencies are considered on the basis of a new modern concept that corresponds to the current stage of development of society [3, 4, 5, 6, 7].

Plutenko et al [4] identified the main approaches to the training of engineers in the engineering industry: personality-oriented, systemic, competency-based and integrative. Moreover, the authors of the article consider the system of professional standards as a fundamental guideline for the development of educational programs for the training of specialists in engineering specialties. The authors also highlight the universal competencies that should be formed during the training of engineers.

Interdisciplinary communications within the framework of the system of disciplines for the training programs for technical specialists Romanov and Krasnopevtsev in their article are considered as a model for improving the quality of training of specialists in this area [9]. Moreover, as a block of this model, the authors propose to consider "the identification of the structural elements of the interconnectedness of disciplines through the sign of professional skills." It is this block, in their opinion, that will allow the formation of professional skills based on an analysis of future production processes. But, in our opinion, the development of a curriculum based on this model will only allow partially forming the competencies of graduates of technical specialties according to the requirements of the external environment.

Today, the education system is tasked with training engineering specialists based on the formation of foresight competencies [10, 11, 12, 13].

The lifecycle of knowledge is a period of time that begins from the moment knowledge is obtained and ends at the time of their complete obsolescence and impossibility of their practical application, and ultimately the lack of demand on the labor market.

Previously, the lifecycle of knowledge was long in time (cascade model) and was characterized by fairly clear stages, unchanged requirements for the education system during the lifecycle of knowledge, understandable requirements from the labor market [14, 15].

Today, the pace of technological change and the introduction of innovation are affecting the knowledge lifecycle. A sharp reduction in the knowledge lifecycle has occurred. Graduates of educational organizations barely have enough time to recoup their investment in education. The lifecycle of knowledge at the present stage can be represented as a forced model.

Figure 1 shows the cascading and forced models of the knowledge lifecycle.

![Figure 1. Cascading and forced models of the knowledge lifecycle.](image)

The only way, in our opinion, is orientation to a spiral model of the knowledge lifecycle (figure 2).
When using this approach, a new educational product is created at each turn of the spiral, the requirements for the set of specialist competencies are specified, the quality of the formed competencies is determined, and a set of training disciplines are planned.

Figure 2. Spiral model of the knowledge lifecycle.

Particular attention is paid to the initial stages of training specialists and the formation of a basic set of foresight competencies – analysis and design of the curriculum, where the feasibility of certain solutions in the design of the educational path is checked and justified through regular “gap analysis” between the system of training technical specialists and market requirements.

In the preparation of technical specialists, orientation to a spiral model of the knowledge lifecycle will help to ensure that the educational product development process will combine both design and phased prototyping of the educational process. This will be developed in order to take advantage of both existing educational formats (downstream) and foresight formats (upstream), which will focus on the formation of competencies that allow the application of knowledge and skills in non-standard conditions, in the face of uncertainty and high risks.

3. Results of a research

At all stages of the analysis and design of the educational process, the relevance and relevance of the formed competencies is checked by analyzing the gaps and creating prototypes of educational programs. At the same time, educational foresight formats are created at each turn of the spiral, focused on the formation of new competencies while maintaining the critical foresight competencies. This allows you to clarify the market requirements for the emerging set of competencies, the characteristics of the educational product, determine its quality, and carry out prototyping of the next coil of the spiral.

Thus, the competencies that a technical specialist should possess are deepened and sequentially specified, and as a result, their set is formed that satisfies the actual requirements of the market and, moreover, is ahead of them.

It should be noted that engineering work has a lower potential for automation of jobs. This area of activity is associated with the practical application of special knowledge that cannot be automated.

When training engineers taking into account the spiral model of the knowledge lifecycle, the level of competence of a particular student can be represented as an upward curve (figure 3).
Figure 3. The cycle of the level of competence of a student in a technical specialty, with the educational process being oriented towards a spiral model of the knowledge lifecycle.

The Global Skills Index (GSI) report, prepared by the world's largest platform for higher education Coursera, presents a global skill index of 60 countries in three areas of business, technology, and data processing. Obviously, the position taken by the country in the ranking is largely determined by the quality of training of specialists in this field, the level of acceleration of competencies of graduates of educational organizations.

Such countries as Argentina, Czech Republic, Australia, Spain, Poland, Belarus, Germany and others fell into the advanced category (rank 1-15) for the development of technical skills. Russia takes 18th position, ahead of countries such as the United States, Britain, Canada (table 1) [6].

Table 1. Global Skills Index.

| Cutting Edge | Competitive | Emerging | Lagging |
|--------------|-------------|----------|---------|
| 1. Finland   | 1. Singapore| 1. Peru   | 1. Malaysia|
| 2. Switzerland| 2. France   | 2. Romania| 2. Dominican Republic|
| 3. Austria   | 3. United States | 3. South Africa | 3. Taiwan|
| 4. Netherlands| 4. Israel  | 4. Brazil | 4. Ukraine |
| 5. Belgium   | 5. Ireland  | 5. Japan  | 5. India |
| 6. New Zealand| 6. Hong Kong| 6. China | 6. Ecuador |
| 7. Germany   | 7. Czech Republic | 7. Greece | 7. United Arab Emirates |
| 8. Sweden    | 8. Italy    | 8. Belarus | 8. Nigeria |
| 9. Australia | 9. Portugal | 9. Mexico | 9. Indonesia |
| 10. Canada   | 10. Argentina | 10. Venezuela | 10. South Korea |
| 11. Chile    | 11. Hungary | 11. Vietnam | 11. Turkey |
| 12. Denmark  | 12. Poland  | 12. Kenya | 12. Pakistan |
| 13. Norway   | 13. Russia | 13. Thailand | 13. Saudi Arabia |
| 14. United Kingdom | 14. Costa Rica | 14. Philippines | 14. Bangladesh |
| 15. Spain    | 15. Colombia| 15. Guatemala | 15. Egypt |

Despite some positive examples, the target setting of the roadmap for the development of the Russian agro-industrial complex by 2019 has not been achieved. So, the share of Russian enterprises using ...
digital solutions should have reached 30%. But the share of domestic developments did not come close to achieving this indicator. The share of developments in the field of ecoengineering is about 10%.

When developing educational programs for training engineers, engineers should pay attention to the experience of countries occupying leading positions in the ranking and included in the TOP-15. The Global Skills Index (GSI) report cites Argentina's model as a positive experience in training technical specialists. Training at universities in the country is focused on acquiring practical skills in the field of technology. In addition, universities in Argentina have developed partnerships with government agencies to stimulate technology entrepreneurship.

4. Conclusions
In the context of the development of the introduction of innovative systems and automation tools, an active approach to the training of technical specialists is necessary. Undoubtedly, the priority should be given to the formation and development of practical skills.

In the world practice, a tendency towards continuing education has been observed for a long time, but, nevertheless, the pace of development of innovation and automation is so fast that university graduates often gain competencies that do not fully meet market demands.

In our opinion, the orientation in the development of educational programs for the training of technical specialists, including engineers, towards a spiral model of the knowledge lifecycle will allow us to develop a model of advanced learning.

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