INSTRUCTIONAL TECHNOLOGY AND HIDDEN PROCESSES: DEVELOPMENT OF PROFESSIONAL SKILLS AND PROFESSONAL ETHICS

Vladimir Romanenko, Galina Nikitina
North-Western Branch of Academy of Information Technologies in Education, Russia
putyatino1941@gmail.com, ladogalake@gmail.com

Abstract. Each learning process is based on two main types of external actions. The first one is the set of preplanned activities of the teaching staff. These actions build the traditional curriculum. The second set of activities is connected with interactions between the students and the university environment. A hidden component can be detected in both of these types of actions. It is not directly associated with the content of lectures and practical exercises. However, this component is very important. The hidden component also creates a number of important knowledge and practical techniques. The list of the main hidden skills and abilities was developed. Simultaneously, students get team work skills and several other important personal behaviours. Some new skills necessary for information work were discussed. The actions which create these behaviours are also hidden. Therefore, these activities are never included in the standard instructional programs and schedules. However, these processes can be controlled. Some ideas devoted to planning hidden processes and their optimisation both directly in curriculum and in environmental interactions are discussed.

Key words: collective discussion, curriculum, educational environment, hidden process, information reliability, information search, interdisciplinary tasks, interpersonal ethics, personal behaviours, personal interactions.

1. Introduction: Hidden Curriculum

All instructional strategies are based on several sequences of preplanned external actions. One can detect two main types. The first type represents a set of activities for the teaching staff. The second set is more complex. It is related to various interactions between the students, university and external environment. The curriculum is built on the first type of activity sequences. Traditional curriculum is built on the intellectual tradition which is a strategy for creating Knowledge, Skills, Abilities and Other individual characteristics or KSAO for particular professions [1; 2]. Whereas some KSAOs regardless of their level [2; 3] are developed in the course of the study of a particular subject – Mathematics, Physics, Chemistry, etc., there are KSAOs, such as a proficiency in using the computer, calculator, handbook, index, table, dictionary, and thesaurus that are essentially of an interdisciplinary nature. They are not explicitly taught. These KSAOs are usually cross circular. They usually emerge as a part of thelearner's repertoire through his or her active participation as an apprentice in the learning environment that encourages direct engagement in the discovery of specific knowledge and other professional characteristics of students.

Interactions between the students, their university and external environment are not directly tied with instructional strategies. Let us, for instance, consider a sequence of actions needed for writing an article. The ability to approach this problem does not depend much on the field of knowledge. Moreover, the solution is not so clear as, for example, the estimation of a measurement error of some size. Although both of these problems are interdisciplinary, the approach to their solution is different. Understanding what the errors are comes as a result of numerous discussions with the teachers and as well as exercises and experiments. As a result of this interaction the students develop a clear method for solving this problem. At the same time one cannot give such a rigorous advice on writing an article. Therefore, only fuzzy recommendations can be developed in this case. As a result, we can say that the two types of cross subject KSAOs differ in the degree of certainty. At the same time they have a common basis. This basis is their creation across the curriculum [4; 5]. It is accepted to speak about these KSAOs as about the KSAOs emerged in hidden processes.

Both types of KSAOs discussed above are created independently from a standard curriculum. Frequently no special strategies are used for their development. Traditionally, only the qualified teacher's experience is enough to get acceptable results in this field. This spontaneity of the occurrence allows us to call the relevant processes as hidden processes. Some time ago these processes were also denoted as shadow processes. Yet, negative connotation with criminal economics forced the abandonment of this expressive term.

Hidden processes were actively studied over the last two decades. It was found that these processes can and should be managed. Therefore, in modern times, it is necessary to detect and discuss the hidden curriculum. One can say there are known to be two curriculums: the first one is a traditional visible curriculum and the second is an invisible or hidden curriculum. Our main goal in this presentation is to give a brief description of some strategies of this new type of curriculum. These strategies are based on expert surveys and the analysis of long term research activity of students.

2. The Content of Hidden Curriculum on the Example of Engineering Education

When investigating the problems connected with the hidden curriculum the first task is to detect the KSAOs developed through hidden processes. For more specific analysis, we review the problems of engineering education. The greatest number of skills spanning multiple subjects is studied in STEM disciplines. They are taught during freshmen and sophomore years. Therefore, one needs to study carefully this period of the Universal Curriculum Core – UCC [6]. The standard approach for detecting them is to poll different groups of experts. A major problem associated with the polling approach is the ability to develop an accurate list of multiple choice questions [7; 8]. An alternative approach is not to use multiple choice questions as a polling tool, but rather to create a list of questions through a polling process. To this end, the classical Delphi method [9] commonly used in the area of scientific prediction was administered. This method has been modified by the authors of the article. It was described in details in [10]. A group of experts consisting of the university faculty ($N = 8$), industrial researchers with advanced degrees ($N = 9$), and practicing engineers ($N = 15$) was asked to create a full list of skills essential for an engineering profession. It took the group three months to complete the task. As a result, each expert came up with his or her own list of responses presented in a loose format. According to the Delphi method, all responses were analyzed and skills common to all the lists were identified and recorded in the final list. According to this method we found a list of the main skills necessary to create at the STEM period of education – Table 1 [2; 6; 10]. There are 20 items in this list.

Table 1

The main engineering skills and abilities which have to be developed in the hidden processes

№	Engineering skills and abilities	№	Engineering skills and abilities
1	Systematization of results	11	To be familiar with PC
2	Streamlining of experimental data	12	Statistical planning data of experiments
3	Estimation of experimental data statistical description	13	Estimations of measuring equipment descriptions
4	Presentation of the results in the diagram forms	14	To make use of the dimensions method
5	Optimal presenting of the results	15	To know literature data search methods
6	To know simple computing methods	16	To know methods of literature data storage
7	To know methods of numerical and graphical problem solving	17	To know modern literature data searching systems
8	To use nomograms	18	To write a short resume
9	To find jumping out results	19	To know the main library indexation systems
10	To be familiar with the methods of graphical derivation	20	To formulate the main results of own work

The attempts to increase their number are not realistic in principle. This is due to the limit of the training time in the schedule. The experts who created this list have ranked the KSAOs according to their importance. It is well known that the technical progress has accelerated sharply in recent years. It changes the KSAOs to be developed in the universities [11]. To answer this challenge, the authors did the same exercise for the determination of a standard set of KSAOs again after some time. The whole number of KSAOs enumerated in Table I did not change. Yet, some of them were replaced by others. In addition, many KSAOs changed their ranks. It was done approximately 8 years ago. Yet, after this time the situation partially changed. The skill number 7 (The use of nomograms) is now not interesting due to the development of computer aided methods of data analysis. For the same reason the interest in skills in line 10 has gone down sharply. At the same time there was a need in assessing the reliability of the information found online. However, the basic structure of the list has remained unchanged until now. This allows us to discuss the problem based on the above table.

3. Various Strategies for Development of Hidden KSAOs

Let us look closely at the list of KSAOs given in Table 1. It is not difficult to understand that the KSAOs are split into several groups. For instance, the lines 9 and 14 can be applied to several professions tied only with Physics, Chemistry and other technical professions. The skill in the line 3 is of an interest to a wider range of specialists. Yet, the skills and abilities in the lines 15 to 20 are necessary for any profession. As a result various groups of hidden skills are needed for development in different ways.

Historically, some first studies of developing hidden KSAOs were for pre-college curriculum [12-14]. It is natural that the content and structure of hidden KSAOs change while moving along the educational span. The hidden KSAOs at the tertiary level are more complex than at the pre-college level. Yet, unlike the elementary and secondary levels, the development of skills through the hidden curriculum at the tertiary level can be controlled through appropriate instruction and special strategies. In practice, it makes little sense to read special lectures aimed at the development of hidden skills. It is much more efficient to develop these KSAOs in practical work. For this purpose each instructor must have special collections of problems and examples, and several lab trainings. A collective discussion of all problems gives a great benefit. Mastering of hidden KSAOs requires repeated returns to the relevant issues. In this regard administration of the teaching strategy has to answer some questions.

The first question is how much time should be reserved for developing hidden KSAOs. It is evident that active work on creating new KSAOs in the hidden strategy reduces the time for developing KSAOs from the visible curriculum. Let us discuss a case when a hidden KSAO is developed while studying only one subject. In the interviews given to us by several independent instructors they said that the best way was to give the hidden process about half of the time. Yet, such situations are random. In the case when the necessary KSAO is developed during the study of several subjects, the problem of matching the theme and the time of exercises and discussions becomes very important. As a consequence, the question arises about harmonization and optimization of multiple educational strategies. At the same time the question also arises about the choice of a common terminology, notations and other factors. It is well known that there are possible various solutions to many problems connected with scientific and engineering practice. Each of them can be recommended to students. Experience shows that students practically always prefer solutions which are common in their environment. Therefore, the best way to develop the students' KSAOs is through discussions in reciting classes when all possible ideas are analyzed under the leadership of an instructor. The discussions at reciting classes about different possible ways of receiving and processing of the results are very useful. In such discussions the instructor has to demonstrate various methods of representing the results. Thus, it is reasonable to show how the presentation of the results depends on the scale on the axes, the indication of errors, etc. An example of such an illustrative demonstration [15] is given in Fig. 1. On the left and right parts of this figure the same set of experimental points is given. Yet, on the left part on the vertical axis they are presented as values $\Delta B/B$ and on the right part as values ln $\Delta B/B$. It is easy to notice that when using the scale ln $\Delta B/B$ the experimental curve reveals a kink. It indicates that a change of the mechanism is occurring. It is necessary to have a set of examples of such type for training students. There are some books known to be devoted to the description of these problems [15; 16].

One needs to understand that such examples are more effective if students understand the essence of the problem. Therefore, each qualified instructor must have a set of demonstration packs. Each pack has to be tied to a specific field of knowledge. The examples in all these packs should be updated periodically. Our years of experience say that the best strategy of implementing these hidden ideas in the students' brains is a detailed study of different content specific examples in laboratories and reciting classes. Familiarity with the theoretical considerations is useful after the development of the necessary hidden KSAOs. The best period of such coerces is the pre-diploma practice.

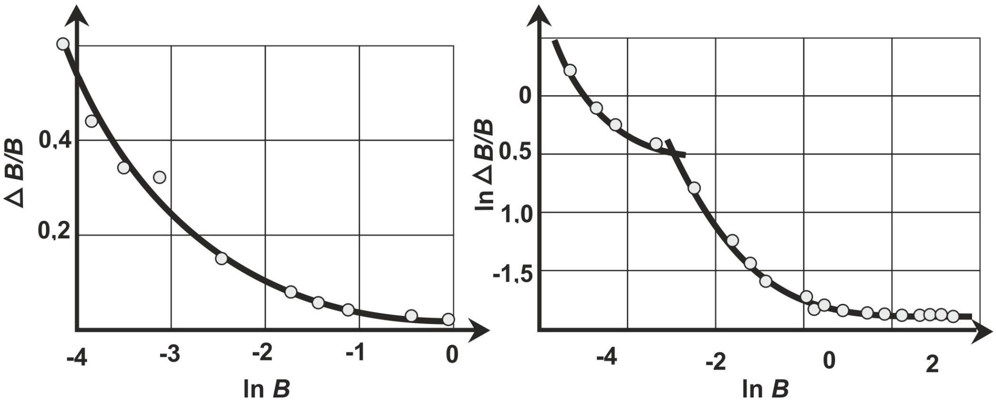

Fig. 1. **Illustration of the role of the scale in the view of experimental data**

4. Hidden KSAOs, Information Search, and Representation of the Results

The ability to work with information is the most important part of the KSAOs of each graduated professional. Their development begins at the primary and secondary educational levels. In most situations all freshmen have some KSAOs in this field, which are developed in hidden processes. In many cases a number of skills develop in the processes of communication with friends and contacts in social networks. As a result, practically all freshmen have technical computer skills and some skills in information work. Unfortunately, these skills are various. Moreover, the freshmen frequently could not really estimate their competencies in this area. Therefore, it is necessary to check their real KSAOs immediately after admission to the university. In addition, it is useful to develop the students' hidden KSAOs in the area of information work following a strategy different from the one described in the previous section. This strategy is more complex. It begins from brief introduction lectures. All forms of independent work follow this. The experience of some American universities shows that freshmen and sophomore students should work with information under the guidance of a qualified librarian. Senior students must have practical training under the guidance of their scientific advisors. At the pre-diploma period it is necessary to give theoretical lectures and a set of practical training in the field of searching for the necessary information.

Information search is a combination of professional KSAOs and some features of art. The search results depend on the ability to formulate the search queries correctly and the ability to choose the optimal sequence of actions. This depends on the experience and cultural background of an individual. It is advisable to train in this field under direct supervision of an instructor. Unfortunately, this is impossible if the number of students is more than 5-6 people. So, the first training must find the students with the best results. After that all the students have to be divided into small groups. In each of these groups, participants are invited to keep track of how information is searched by the strongest students. The aim of the instructor is to group the students correctly and analyse the results during discussions in reciting classes. Our experience shows that this method of training is the most effective. Naturally, the sequence of the solved search tasks must follow a specific strategy.

Traditional teaching of information work says there are three main problems which the user wants to master. They are: *how to find information*, *how to store information* and *references and how to represent new information created by an individual* [15]. The bulk of educational and scientific literature is devoted to the familiarity with these issues and building of appropriate KSAOs. These KSAOs are also developed in the hidden processes. Recent decades have dramatically increased the possibility of finding new information. The appearance of the Internet has simplified information searching. Now a huge stream of news comes in the hands of an average user. As usual, the cost of the increase in the amount of new information is lowering its quality. One can say there is a standard rule: *it is impossible to expand the volume of any material without compromising its quality*. The result is a new basic problem of learning, namely, the development of skills to evaluate the quality and reliability of the information found. Currently the solution is implemented by the help of hidden processes. They are based on studying of practical experience under the supervision of experienced advisors. Not all university departments are familiar with these problems. Therefore, the development of the necessary strategies and different text books is the main focus when developing the KSAOs for work with information.

5. Hidden Implementation of Personal Interactions

The hidden processes are responsible for cultivation of social properties of an individual, too. There are some special ways which help the teachers examine the hidden processes. These ways vary depending on the situation and subject [17]. Yet, the strategies for realisation of the necessary actions are various. So, it is only possible to enumerate some practical recommendations. It is possible, for instance, to invite the learners for their common interviews to describe their impressions from contacts with the students from different countries, of different sexuality, age and religion. It is also well known that the educational process depends on external information coming to the students from TV programs, books and personal contacts. So, continuous study of the students' interests is an important part of education strategies connected with creation of the students' tolerance. The study of students' library cards is one of the methods which gives information about their interests. Different interviews also give the teachers understanding of which journals and TV programs are in the field of the students' interests. The tutor can find a lot of useful information in social nets. Each instructor must have some new interesting examples for explaining the importance of understanding one another. The optimal strategy to affect the hidden processes in the students' community represents only rather fuzzy recommendations. It is a very interesting and perspective goal for further investigations of this problem. The main result of this study is development of a hidden strategy to create professional and interpersonal ethics.

6. Main results

The main results of our investigations.

- There are 20 main KSAOs found which have to be developed in hidden processes at the tertiary level.
- The hidden KSAOs are weakly changing with time.
- Implementing of the Internet technologies put the question of ability to evaluate the quality and reliability of the found information.
- Hidden processes are important for the creating students' tolerance.

All these results are important for increasing the effectiveness of training.

7. Conclusions

Hidden processes are a very important part of each learning strategy. There are two main types of these processes known. The first one is connected with creating specific content KSAOs which are a base of the hidden curriculum. This type of the hidden field was studied for several decades. One can recommend different strategies for its realisation. The focus of the next efforts in this area is creating the necessary text books and practical exercises for optimisation of these processes. The second part of the hidden processes is closely related to implementation of some personal behaviour which becomes imperative in a multicultural environment. There is a set of practical implementations and ideas to develop a promising strategy in this area. This work is one of the main goals for the future.

References

1. Booth A. Developing history students' skills in the transition to university. Teaching in Higher education vol. 6(4), 2001, pp. 488-503.
2. Abramovich S.A., Nikitina G.V., Romanenko V.N.Developing practical competence of future engineers within a theory-oriented curriculum at the tertiary level. Herald of Education and Science Development of Russian Academy of Natufral Sciences vol. 4 (Special issue), 2002, pp. 24-30.
3. Romanenko V., Malonovska L., Nikitina. G. Some aspects of skills and competences in engineering Education. Proceedings of conference "Engineering for Rural Development", May 27-28, 2010 Jelgava, Latvia vol. 9, pp. 296-301.

4. Bunker A., Schneider J. Writing across the curriculum in a human physiology class to build upon and expand content knowledge. Athens Journal of Education vol. 2(4), 2015, pp. 331-343.
5. Kundu D.K. Nature of the Information Seeking Behaviour of Teachers Engaged in General Degree Colleges and Teachers' Training Colleges: A Critical Analysis. Athens Journal of Education vol. 2(3), 2015, pp. 257-273.
6. Romanenko V., Nikitina G. Instructional technologies of the XXI century: Theoretical approach. In: "Handbook of research on applied learning. Theory and design in modern education. (2 volumes) Hershey, PA, USA: IGI Global vol 2, Chapter 7, 2016, pp. 145-164.
7. Klauer K. Teaching inductive reasoning: some theory and experimental studies. Learning and Instruction vol. 6(1), 1996, pp. 59-76.
8. Lemos M.S. Students' and Teachers' goals in the classroom. Learning and Instruction vol. 6(2), 1996, pp. 51-71.
9. Rowe G., Wright G. Expert opinions in forecasting. role of the Delphi technique. In J. S. Armstrong (Ed) "Principles of Forecasting: A Handbook of Researchers and Practitioners" Boston: Kluwer Academic Publishers. 2001, pp. 125-144.
10. Никитина Г.В., Романенко В.Н. Формирование творческих умений в профессиональном образовании (Development of creative abilities in vocational education). (In Russian). СПб: Из-во СпбГУ, 1992, 166 стр.
11. Krivickas R.V. Krivickas J. The new college system of engineering education in Lithuania. Proceeding: "7-th Baltic Region Seminar on Engineering Education", St-Petersburg, Russia, 2003, pp. 115-116.
12. Overly N.V. (Ed.). The unstudied curriculum: its impact on children, by the ASCD. Elementary Education. Washington, DC: "Association for Supervision and Curriculum Development". 1970, 130 p.
13. Vallance E. Hiding the hidden curriculum: An interpretation of the language of justification in nineteenth century educational reform. Curriculum Theory Network 1, 1983, pp. 5-21.
14. Skelton A. Studying hidden curricula: developing a perspective on the light of postmodern insights Curriculum Studies. vol 5(2), 1997, pp. 177-193.
15. Романенко В.Н., Орлов А.Г., Никитина Г.В. (1987) Книга для начинающего исследователя-химика (A book for the novice researcher-chemist) (In Rissian) Л:. ЛО 1987 280 с.
16. Sharaf V.A., Illman D.L., Kowalski B.R. Chemometrics. NY; / Chihester / Brisban / Toronto / Singapore John Willey & Sons Inc, 1982, 352 p.
17. Romanenko V., Nikitina G. Some Problems of Intercultural Education. Международный журнал экспериментального образования (International Journal of Experimental Education) 2009(1), pp. 9-11. [online] [28.01.2016] Avaiable at: http://www.rae.ru/meo/?section=content&op=show_article&article_id=202