Modern Practices of Teaching Materials Development for Higher Polytechnic Education

Z Ivanova[1], S Shvedov[2]

[1]Associate professor, Department of Social, Psychological and Legal Communications, Moscow State University of Civil Engineering (National Research University), Yaroslavskoye Shosse, 26, Moscow, 129337, Russia
[2]Head of International Projects Office, Moscow State University of Civil Engineering (National Research University), Yaroslavskoye Shosse, 26, Moscow, 129337, Russia

E-mail: stefan.shvedov@mail.ru

Abstract. The article raises the question of the need to strengthen the polytechnical element in higher education and to combine knowledge and skills from natural, technical and social sciences. Today the training of new specialists requires a transition from traditional training materials to a new generation. From one side there is an economical context: changing labor market, constant technological transformations, and the disappearance of some industries and the appearance of others. And from the other there is a change in the way of thinking of modern youth – "clip" consciousness. The authors examined the modern practice of forming educational materials for construction specialties. Also, a sociological study was conducted by observation, experiment and interview methods in MGSU - Moscow State University of Civil Engineering (National Research University). The objects of the study were the students of in engineering and architectural courses on the undergraduate, MSc and PhD levels. Students' answers revealed their desire to expand theoretical and practical polytechnical knowledge, to meet the current level of requirements, to be prepared for sudden changes in the place of work and position, the nature of the activity. The studies also revealed students' attitudes to existing educational materials, the need for changes, and also confirmed the results of previous studies in different countries (in particular, in universities in the USA and South Africa). It was confirmed that students still need a certain number of paper materials, and not just electronic ones, which create a feeling of weariness and fatigue, the so-called "Technostress". The structure of textbooks and handbooks, their design, and the supply of elements of augmented reality also require changes.

1. Introduction

The modern world is changing rapidly. Dramatic changes are taking place in all spheres of life. Many societies find themselves in a situation of "cultural lag" when the accepted "picture of the world" lags behind reality; technique, technology are ahead of the development of such areas of culture as values and norms, stereotypes of behavior, ways of thinking. Global informatization and digitalization link together spheres and branches of life, productions, professions and occupations. It is impossible to consider in isolation from each other science and technology in engineering, architecture, urban planning and construction. They are closely connected, interdependent. Polytechnic education is becoming more and more popular - mastering the knowledge of the natural and social sciences -

mathematics, physics, chemistry, geology, sociology, psychology and the acquisition of general technical and social skills. The elimination of natural and general technical subjects from the curriculum and narrow specialization of the graduate, the restriction of textbooks and teaching materials purely within the framework of a narrow specialty leads to the formation of a future specialist with a narrow horizons, limited skills, inflexible and incapable of understanding causal relationships in the field of his activity. For example, today we meet with highly specialized doctors who are not capable of diagnosing diseases and complex treatment, since they are not able to see the relationship of elements in the functioning of a biological organism, as well as its dependence on a social organism. As the Russian researcher - psychologist Ewald Zeer, notes, the previous targets - mastering the profession - are being transformed into general professional training, which should be characterized by integrative, metaprofessional content [1].

On the other hand, modern processes spontaneously change the way we perceive the world and, accordingly, the picture of the world. They change the way we think and process information. In the 1970s, American futurologist Alvin Toffler gave a forecast of upcoming changes, the formation of a new information culture: blip culture and blip perception of information [2]. According to Toffler, this is a fragmented-mosaic perception of information and the formation of a fragmented-mosaic view of the world. He calls this form of perception of the world "zapping": it is as if a person constantly switches television channels and receives only bits of information. He is incapable of creating a coherent, connected picture of the visible. His image of the world consists of disparate images and impressions.

Later, such a culture was called "clip culture", and the way a person thinks is called "clip thinking" or "clip consciousness" [3]. Modern children and youth are getting used to clip perception. Today the entire mass music industry exists in the form of video clips. Children's cartoons are also clips: quick change of pictures, speed, expression, constant updating of information. The shape and speed of the change of frame themes in a modern movie has also changed. The world is oversaturated with video and audio information, but it is extremely simplified and does not require comprehension, analysis and reflection.

F. Girenok believes that the conceptual thinking of a young person has ceased to play an important role in the modern world. Linear, binary thinking is being replaced by non-linear thinking [3]. Obviously, the increasing flow of information requires its reduction and simplification of perception, and the heterogeneity of information and the expansion of the interests and occupations of young people do not leave time for its reflection and analysis. Therefore, clip thinking involves simplifying the assimilation of material, ignoring its depth [4]. According to modern researchers, clip thinking is "a whole range of stylistic features of cognitive activity, including the predominance of visual processing of information over semantic and high speed of information processing against the background of a decrease in the possibility of generalizing and restructuring it" [5]. Therefore, these characteristics lead to a decrease in the effectiveness of educational activities in the context of traditional educational models and the use of traditional teaching materials, which sets the task of radical changes in the preparation of teaching materials for pupils, students and teachers themselves. Features of thinking of modern youth require the creation of educational materials of a completely new generation. Indeed, today new teaching materials are created for children age up to 12, oriented to their specifics of perception. While classical textbooks with so-called "blind" text in form and "boring" in content continue to be developed for university students. Often "for the sake of economy" only text is present in textbooks and illustrative material is completely missing. Moreover, the analysis of textbooks and handbooks on construction specialties shows that they are very narrowly specialized, they do not have polytechnical knowledge, for example, textbooks for future specialists in high-rise construction, and there is no information about the environmental consequences of high-rise building technologies.

2. Literature review

There aren't many works devoted to questions of the methodology of creating entirely new educational materials. Today, the attention is paid to improving the educational process itself: the creation of new teaching and learning technologies, the development of active learning forms, the introduction of information and communication technologies in the educational process. The writing of textbooks and the development of teaching materials of a different format and content is not in a trend now. First of all, consider the literature that directly relates to the chosen topic.

A number of works of interest to our problem concern the forms of interaction between the teacher and the student, since the type of training materials depends on the form of interaction. If students study full-time and meet with the teacher constantly, listening to lectures and completing assignments in a practical lesson, educational material is required as an addition to the educational process. Teachers have the opportunity to answer questions and individually consult students. In addition, they can use the capabilities of the Internet by creating their blogs and sharing educational material for their students, on their level of preparedness and specific goals. Creating a blog or website on the Internet turns the teacher into an actor, reducing the virtuality of the general information and educational environment [6]. Using empirical studies, it was found that it is possible to provide a higher degree of learning from the use of blogs, since the benefits of using blogs are due to the generally positive attitude of students to the use of electronic technologies in teaching and learning.

For distance learning other types of training materials are required. First of all, these are digital textbooks, which are an indispensable tool for students who are not able to attend regular classroom classes. According to some researchers, the educational process with the use of electronic textbooks is more exciting and memorable for students. It ultimately has a beneficial effect on students' learning of material. But not everything is so simple. Printed publications and electronic textbooks have their drawbacks and advantages.

The analysis of the differences between electronic and printed teaching materials is the work of young Russian researchers from Ufa, Russia. The authors make a choice in favor of electronic educational publications, seeing the only drawback is that not all students have the opportunity to purchase computers or tablets. They include the high level of decoration, the quality of technical performance, visibility, consistency and consistency of presentation of the material to the advantages [7]. However, in another study conducted in the Republic of South Africa, the author captures the negative aspects of electronic materials, noting their very average level, and also warning about the dangers of technostress when used [8]. The results of the study, conducted by the author, show that most sample educational materials for textbooks are only suitable for teaching from low to intermediate levels in accordance with the revised Bloom Taxonomy. Most of the resources studied lack sophistication and complexity to support high-order learning, which involves interaction between students and teachers on e-learning platforms [9]. Such a difference in grades is probably due to the fact that the authors studied different training materials and based on different assessment criteria. In fact, a lot depends on the skills of the authors. In general, electronic publications certainly have great illustrative capabilities.

The Internet is a rapidly replenished repository of information. It provides much greater opportunities for the accumulation and presentation of material, both in form and in content. Today, more and more educational Internet resources are created where everyone can find the required material. A number of publications [10, 11] have been devoted to the characterization of Web 2.0 services focused on the provision of educational content via the Internet.

And, finally, we can single out works, where authors give methodological recommendations on the development of various types of training materials: textbooks and handbooks. These publications set out the requirements for the compilation, structure of the textbook depending on the level and form of training, to a certain extent they take into account the current level of development of information and communication technologies and the peculiarities of students' perception of the information contained. [12-19].

3. Objectives and methods of research

The purpose of the article is to study the needs of students, their opinions regarding the form and content of modern educational materials and develop recommendations for creating new ones, taking into account the specific thinking of modern students. First of all, it applies to the polytechnic higher education, designed to provide knowledge and skills in the field of solving a wide range of industrial and technical problems and involving various forms of self-education and self-development.

The main methods used in the study:

1) an informal field observation of the behavior 4 groups of 3rd year students studying in practical classes ("Architecture", Moscow State University of Civil Engineering (National Research University) – MGSU). The purpose of observation: to establish how often students turn to tablets, laptops and phones, trying to find an answer to the teacher's request to "think";

2) a field experiment with 4 groups of 3rd year students ("Architecture" course, MGSU) was intended to find out how many students use the recommended textbooks and handbooks in preparation for the assessment;

3) a free interview with MGSU students (different engineering courses) to clarify their requirements for modern educational text materials.

4. Research results

A sociological study using field observation methods and a field experiment was conducted MGSU March – June 2019. The object of the study was 4 groups of 3rd year students ("Architecture" course)

Observation was carried out in practical classes in the discipline "Sociology of space and architecture" in 4 groups. The purpose of the observation was to establish the ability for independent thinking and analysis. The results of observations for each student were recorded in the control journal.

At the first practical lesson, students were provided with workbooks on the subject with practical assignments on 8 topics. Workbooks include tasks for practical exercises and assignments for independent homework. The teacher drew students' attention in advance what tasks (cases, role-playing games, tests) would be performed in the next lesson.

As a result of the constant observation and recording of facts, it was revealed that the majority of students do not find it difficult to deeply and independently analyze the material. Tasks that focused on self-analysis were performed unsatisfactorily. It was checked, that more than half of the group had the same answers (thoughts). Answers were shallow and superficial. It indicated a reluctance to delve into the essence of the problem and a sharing of the answers between students. During classes, at the teacher's request, to state their point of view, students didn't respond looking into their phones and tablets. They tried to find a ready-made answer online instead of trying to think about the problem on their own. The results of the observation confirmed the inference that with the availability of extensive information in the Internet and free access to it at any time, students gradually lose their ability to analyze and to think independently.

The results of a small experiment show that modern students also lose interest and the ability to systematically work with textbooks and other teaching materials, relying that they can find answers to any questions in the Internet at any time. The essence of the experiment was that the students were not only recommended to use the textbooks from University Library of MGSU (in print or electronic form), but also textbooks and additional teaching materials that were sent to each student by personal e-mail. They were intended to write an essay and prepare for practical exercises and standings. Only 30% of the students in each group submitted the first self-written essay for the first test. In 47% of students, more than 50% of the material in the essay was plagiarized. The work was returned to them. 9% of students presented full plagiarism. 14% of students did not complete any task. Specific tasks for filling knowledge gaps from missed topics were completed only by students who were supposed to do this in writing way. They used the materials sent by the teacher and made extracts. More than 70% of those who had the task to prepare for the oral assessment did not use the textbooks sent and did not

prepare for the test. The results of the experiment also showed that many students ignore textbooks even if the teacher supplies each with teaching material and no effort is needed to find it.

The interview (June 2019) was aimed to find out how students of a technical university evaluate the introduction of polytechnic content in training, what educational and teaching materials are preferable for them, what modern textbooks and handbooks should be. 9 students from MGSU have been interviewed: all of them study in engineering areas on different levels of education (bachelor's degree, specialty, postgraduate study). The interview format is a telephone / personal conversation of 10-30 minutes.

Answers specific to most respondents:

• Students are aware of the need to strengthen the polytechnic element in technical (civil engineering) education. Even at the stage of preparing the semester work or thesis, it turns out that they don't have some knowledge or it is fragmentary and unstructured. It not enough to solve the problem at the modern technological level, in the relationship of the entire life cycle of the construction object. Students cannot find the relationship of technology and construction processes with environmental and social consequences.

• Paper training materials are more familiar and comfortable to use. But it happens that in the library there are not enough copies for all students. New textbooks are also very expensive to buy, which is critical for students. Respondents note that the textbooks are quite heavy to carry with them to the university. As a minus, it was noted that information obsolescence in applied textbooks. Many textbooks and guidelines have not been reprinted for several years, and contain errors (publishing / technical).

• Electronic learning materials encounter a number of barriers to widespread use by students. The most common answer is the lack / low quality of mobile phones / tablets for reading electronic textbooks. In addition, not all textbooks can be found in electronic format or require purchasing, which is a serious obstacle for the user. Among the positive characteristics was the absence of a fee for majority of materials, easy navigation through the document, adding comments and notes, the possibility to zoom figures and diagrams for a more detailed study and links to Internet resources.

• Many respondents report a complicated format for presenting the material, both in terms of style and language, and insufficient explanation of the material: lack of drawings, graphs, omission of the explanation behind the words "obviously", "through simple calculations", "as described in the previous chapter".

• To questions on the structure of the textbook, respondents mentioned the importance of table of contents and navigation in the text, examples in theory and practice. To clarifying questions about control questions, a list of references, a glossary of terms and a welcome word, interviewers negatively responded to control questions that are not used, and which may go beyond the scope of the material presented. Respondents find useful a glossary of terms, but have the practice of searching for meanings of unfamiliar words on the Internet.

• All respondents, students of engineering courses, reported that they watch videos on the Internet (YouTube) in addition to written training materials (the example was the discipline "Construction machinery and mechanisms", which is not provided with visual material). The idea of including links (QR code, quick links) was positively received by respondents, but some noted that they would still seek additional information on their own.

Students also criticized the appearance and design of most Russian textbooks and handbooks. They noted: ugly covers, small and dense font, the use of stock images, small drawings of poor quality.

As wishes, they expressed ideas about reviving textbooks with illustrative material to increase their attractiveness and visibility, in particular, providing information in different formats: theory, calculations, tables, practical examples, and drawings. In addition, students praised the use of augmented reality technologies to enhance the visualization effect. Augmented reality will enable students to act on an object, for example, twist an object from all sides, see its internal structure, evaluate the influence of another object on it and allow a more in-depth study and understanding of the object [20].

5. Conclusion

The studies allow us to draw the following conclusions:

• It is necessary to strengthen the polytechnical part in modern higher education, to rebuild traditional courses into comprehensive, interdisciplinary ones. It will require a transformation of the whole concept of modern engineering education, including civil engineering, a change in the existing model, a revision of curricula and the restructuring of the educational process. To shift the emphasis to the training of a wide-profile specialist, who can quickly change depending on the market conditions and corresponding changes in the nature of work? What is needed is a "revolution" of education in accordance with the "information" revolution and the global changes of modern civilization.

• Radically change the approach to the creation of textbooks and teaching materials for students of higher educational institutions. Authors of teaching materials, university professors, should follow the peculiarities of thinking of a modern youth, modern "image of the world", preferences and interests.

• Since modern youth have fragmented (clip) thinking, and also lack the ability to master a large amount of material, perseverance and patience, large amounts of information should be split into portions, preserving their logical connection and providing a systematic and holistic picture of the object being studied. It is advisable to introduce 'milestones' - a phased summarization of the material presented.

• It is necessary to introduce the scenario of "personalization" - an individual approach to the student's personal needs, the selection of teaching methods and means taking into account the interests, needs, motivation of the student. The introduction of such an approach for non-electronic learning is carried out by many university teachers despite the growing trend towards the unification of educational (work) programs and control by the educational administration of universities. More opportunities are open for personalization by electronic forms of education, as the student learns the material or performs exercises with the effect of "real presence".

• Cognition of the world "through pictures", rapidly changing and scattered, and not through a "letter" - the text will require the supply of paper textbooks and handbooks with pictures - illustrations, and, if possible, applications with "augmented reality". As it turned out from the survey, modern students still prefer paper editions, as more "easy" and familiar ones. It should be noted that our studies have confirmed the findings of researchers from South Africa about technostress from the use of only electronic publications [8].

• Blogging or the creation of websites by teachers who could accumulate learning resources on the subject. Interviewed students approve of teachers' blogs, confirming studies conducted at the University of Plymouth (USA) on the usefulness of blogging by teachers [6].

6. Acknowledgments

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