



# MODERN INFORMATION TECHNOLOGIES IN HIGHER EDUCATION: WHAT MIGHT THE ROLE OF A TEACHER LOOK LIKE IN A MODERN UNIVERSITY?

Suleimenova K.<sup>1,\*</sup>,  
Suleimenov I.<sup>2</sup>,  
Egemberdyeva Z.<sup>3</sup>

<sup>1</sup>University of Birmingham,  
Birmingham, UK

<sup>2</sup>Almaty University of energy and  
communications,  
Almaty, Kazakhstan

<sup>3</sup>Institute of information and computing  
technologies,  
Almaty, Kazakhstan

## Abstract:

A comparison is offered between the nature of the educational process in modern universities and classical universities that existed in the XIX and XX centuries. It is shown that the decline in the quality of education in modern universities is largely due to the significantly increased workload (more than 10 times) over the past hundred years, which greatly complicates the conduct of research by full-time teachers and actually cancels the principles of Humboldt. It is clear that modern information technologies allow a return to the implementation of Humboldt's principles at a qualitatively new level. This can be provided by transition to the organization of educational process in "autocatalytic" mode when the information resources providing educational process are maintained by professional, non-academic staff. In this case, the role of the professorship is refocused on the performance of curatorial functions.

## Keywords:

University science, quality of higher education, information technologies, teaching staff, modernization of higher education.

## 1. INTRODUCTION

The key to the question in the title of this article is not as obvious as it may seem at first, especially if we consider teaching on graduate programmes, particularly those associated with the most rapidly developing areas of science and technology (information and telecommunication technologies, nanotechnology, etc.).

This can be proved by comparing the situation that took place at the turn of the XIX and XX centuries and now.

The turn of XIX and XX can indeed be chosen as a reference point, since it was at this time that the modern era can truly be said to have blossomed [1]. In addition, in this historical period the transition to mass higher education begins, accompanied by a pronounced professionalization of science [1].

## Correspondence:

Suleimenova K.

## e-mail:

k.suleymenova@bham.ac.uk



## 2. BASIC FUNCTIONS OF THE TEACHER AND HUMBOLDT'S PRINCIPLES

If we approach from the standpoint of information theory, in the period under consideration the basic functions of a University teacher (as a teacher) should be defined as follows:

- ◆ selection of the most useful information for learning from current scientific literature;
- ◆ systematization of information relating to a particular specialism;
- ◆ transformation of this information into a convenient form for students to learn;
- ◆ overseeing the actual learning process (classroom, exams, etc.).

It should be underlined that in the classical university model, the educational process was only one of the functions of the “teacher” and, indeed, many prominent academics have prioritized their research without detracting from their standard of teaching or student interaction.

Evidence of this is both well-known historical facts [1] and the famous principles of Wilhelm von Humboldt, who managed to convince the Russian king of the need to create a new University model (1808).

The fundamental principles proposed by Humboldt as the basis of a new type of University are *academic freedom and the unity of research and teaching/learning* [1-3].

At Humboldt University the core of the educational process was based not on the principle of transmitting the unchanged essence of accepted academic wisdom. According to Humboldt, a true specialist cannot be trained solely through transmitting a set of certain established truths; this can only be done by involving the student in scientific processes. That is, not an offering of certain truths, but only engagement in research processes allows students to learn science.

Science classes become the most important component of the educational process [1-3], and this statement applies to both students and teachers. The student acquires and consolidates knowledge directly in the process of scientific research, which is carried out by them in conjunction with the supervisor. Teachers, conducting research continue to learn themselves and by learning, they teach others. Simplifying, the principles of Humboldt claim, that the University teacher should be learning throughout their life. The prerequisite for this is academic freedom—it is assumed that a specialist in a

particular field knows better than others what to do in order to best carry out research in a particular field of science.

Humboldt's principles were put into practice in the vast majority of the world's leading universities in the XIX century, in an era when the political elites of European countries not only clearly understood the importance of the development of science and technology, but were also closely associated with the scientific community [1]. These principles have proven to be the best. In particular, it is the combination of academic freedoms with the scientific activities of teachers that made it possible to create numerous University textbooks, which left a mark in the history of science and pedagogy.

## 3. THE TEACHER AND THE CONTENT OF HIGHER EDUCATION

As history shows, a good University textbook can be created only by an active scientist, fully immersed in the appropriate information environment, or rather the person for whom science is not a craft, but the meaning of life, the only acceptable form of existence for them in this world.

This returns us to the above list of functions of the University teacher (lecturer). Each of the items on this list corresponds to the specific stages of the birth of a University textbook worthy of the name. It is obvious that in the conditions of rapid development of science (as was the case throughout the XIX century), the University textbook should combine novelty and fundamentality, to present new provisions in close connection with the basic results accumulated in the relevant field of knowledge.

Somewhat simplifying, we can distinguish the following stages of the birth of a University textbook:

- ◆ the appearance of the primary scientific material reflected in the original scientific papers published in scientific periods;
- ◆ primary systematization of the available scientific material in literature review articles;
- ◆ systematization of the material in monographic publications with parallel development during lectures;
- ◆ consolidation of information that has stood the test of time in University textbooks.

This scheme for many years remained not just an ideal, but was considered as the only acceptable practice. It is appropriate to emphasize once again that



academic freedom was the necessary condition for its implementation in practice; throughout the XIX century, such freedoms were not only a declaration, they were embodied in reality.

Indeed, the realization of academic freedom requires appropriate conditions, which were in place during this period of time. As noted in [4], at the beginning of XIX the volume of academic workload in the University Charter was not defined at all. An indication of what it could be, is given by the Charter of the Pedagogical Institute (St. Petersburg), in which professors read, depending on the disciplines taught, lectures on 3-4 astronomical hours a week.

In the cited work [4] it is also noted that during the reign of Nicholas I, University freedoms were limited, and the duties of the teaching staff, on the contrary, increased. Article 86 of the new University Statute of 1835 reads: “the Professor is obliged to teach his subject at least 8 hours a week” [5], CIT. on [4].

During the period of professionalization of science and the transition to mass higher education, the situation has changed. Thus, according to the standard regulations on the procedure for planning the teaching load of the teaching staff, approved by the orders of the ministry of higher education of the USSR No. 520 of 17.07.87, the actual teaching load of the teacher had to be from 450 to 1000 hours per year, including at least 150 hours of classroom (for professors and associate professors). Currently, the situation is only getting worse: for example, in Kazakhstan, the typical academic load of the teaching staff for the academic year is 23 credits for natural and technical areas and 25 credits for social sciences.

Academic freedom continues to be discussed now; in any case, the relevant debates are recorded in the documents of many Kazakh universities.

However, even if such freedom is available in theory, teachers cannot use them in practice, because in addition to the immeasurably increased (compared to the late XIX and early XX centuries) workload, teachers are forced to spend considerable time on drafting bureaucratic papers and meetingsetc.

This could not affect, among other things, the quality of teaching materials and teaching aids. The vast majority of them, compiled by teachers on duty, does not stand up to any criticism; it is an untalented compilation of information from open sources, the content of which is often selected randomly, only on the basis of compliance with formal requirements. In fact, the vast majority of teachers

use the same methods that students use when writing essays in their textbooks. It is not surprising that both have long turned to profanity, especially if we talk about the most rapidly developing areas of knowledge (information and telecommunication technologies, for example).

It is not surprising that many teaching materials on the content and quality are no different from student papers, and this fact is a very clear illustration of the transformation of the functions that University teachers currently perform.

In a certain sense (especially if we talk about information and telecommunication technologies) teachers and students of post-Soviet universities were in the same position - and those, and others draw information from the same open sources (often different internet resources), only one retells this information in lectures, and others - in exams.

It is obvious that the teacher, overloaded with bureaucratic nonsense and current classes, will not be able to understand the material contained in open sources any more deeply than the student. As the current practice shows, very often the reverse situation occurs. This becomes especially evident in relation to the field of telecommunications (undergraduates who actually work in the units of Kaztelecom often openly laugh at the absurdities that are voiced at lectures by teachers familiar with the latest telecommunications equipment only on the poor internet resources, composed by the same poor fellows as themselves).

Generalizing, it can be argued that in modern conditions *de facto* there is a certain competition between teachers and students (or rather, those who really seek to acquire knowledge). The sources of information are the same for the vast majority of teachers and students., As such, the scheme of writing textbooks and preparing lectures, described above, no longer works (including objective reasons related to the rapid obsolescence of information, especially technical nature).

Therefore, except for some nuances, “the game is on an equal footing”. Theoretically, on the side of the teacher such factors as experience and immersion in the appropriate communication (professional) environment should provide an advantage. Indeed, the most effective way to obtain information on the specialism is direct communication with colleagues (at conferences, in private conversations, etc.). Due to immersion in the professional environment, the teacher (even being a full-time scientist only in part) has the opportunity to form judgments and opinions at an expert professional level without wasting time.



This factor continues to operate in European universities (which, apparently, explains the relatively high quality of European education that still exists). However, in relation to post-Soviet universities, it can be stated with certainty that the factor of immersion in the professional environment has ceased to operate.

Visiting an international conference by a teacher of post-Soviet universities is an event. In any University there are only a small number of teachers who regularly communicate with foreign colleagues. In such countries as Kazakhstan, there is also a factor of low communication connectivity of the professional environment: very often, even within the same Department, teachers do not discuss scientific issues, as they write works in completely different directions. All have long been accustomed to the fact that at meetings of graduate departments of post-Soviet universities often discuss any issues other than the actual scientific. In the vast majority of Kazakh universities, the rarest event is the discussion of scientific issues at scientific councils, etc.

#### 4. THE TEACHER AND THE COMPETENCE OF BACHELOR DEGREES AND MASTERS

As a result, the only advantage of the teacher of the Kazakh University relatively to the student (if we talk about the assimilation of new information from open sources) is their experience. However, in modern conditions this advantage is questionable, as many University teachers (especially under the age of 35 years) acquire less experience of scientific activity, and more experience of drawing up bureaucratic papers.

This state of affairs can be illustrated by simple formulas. The teacher retains an advantage over the student, if the product of the time they spend on the assimilation of new material, the speed of its assimilation exceeds the same figure for the student:

$$v_1(T_1 - \tau_1 - \tau_2) > v_2(T_2 - \tau_3) \quad (1)$$

where  $v_1$  and  $v_2$  are the speeds of learning new information by teacher and student, respectively;  $T_1$  and  $T_2$ , the time of their activity;  $\tau_1$  and  $\tau_2$  - time teacher is engaged in non-academic work and the learning process, respectively;  $\tau_3$  - unproductive (from the standpoint of learning) time of the student.

For post-Soviet (specifically, for Kazakhstan) universities, we can also write the following expression for

the indicator  $v_1$ , which *de facto* reflects the experience gained by the teacher

$$v_1 = k \int_0^t (T_1 - \tau_1(t_1) - \tau_2(t_1)) dt_1 \quad (2)$$

The record takes into account that over time, the teacher's time spent on bureaucratic activities may decrease. However, for teachers under the age of 35-40 years, which in the near future will play a main role in Kazakhstan's higher education (due to the natural loss of personnel trained during the existence of the USSR), this factor is unlikely to matter. Therefore, we can rewrite thus:

$$k(T_1 - \tau_1 - \tau_2)^2 \tau_0 > v_2(T_2 - \tau_3) \quad (3)$$

where  $\tau_0$  - duration of experience (teaching experience).

The indicator  $v_2$  obviously has a significant spread, but this does not change the conclusion that can be made directly on the basis of the formula (3). There is a critical value of the indicator  $(\tau_1 + \tau_2)_{kr}$ , above which the teacher will absorb information much less effectively than the student. Moreover, this critical threshold should be determined, focusing on the part of students who are most motivated to study, i.e. the maximum value of  $v_2$  and the minimum value of  $\tau_3$ .

It is the most motivated students who *de facto* form an opinion about the teacher in the study group; if such students explain to fellow students that the teacher is talking nonsense, the whole group will stop engaging. According to bureaucratic papers, everything will look as it should, but in fact, such a course of lectures will turn into profanity, which, alas, is often the case in practice.

It is obvious that as the volume of bureaucratic papers compiled by teachers increases (which is the case in practice), sooner or later conditions will be created when the critical value  $(\tau_1 + \tau_2)_{kr}$  will be achieved. Of course, it is difficult to specify the specific numerical values of the indicators appearing in the above equations (the formulas are given only for illustration), however, there is every reason to believe that in modern conditions the following already takes place:

$$(\tau_1 + \tau_2) > (\tau_1 + \tau_2)_{kr} \quad (4)$$



This is corroborated by the analysis of methodological materials compiled by teachers of Kazakh universities. As noted above, many of them are inferior in quality and depth of coverage relatively to students' abstracts available on the free market.

We can conclude that the principles underlying Humboldt University are no longer implemented in modern conditions, at least in the post-Soviet space.

Therefore, it is necessary to radically transform the approach to the organization of the educational process in universities.

We emphasize that the transition to a high classroom workload for teachers partly took place for objective reasons. In the first decades of the XX century, higher education became widespread. Today, more than half of the relevant age group in Kazakhstan are University students. It is obvious that in such circumstances, maintaining the academic load at the level of the early twentieth century would require a number of teachers that no country in the world can afford. It is appropriate to emphasize that the problems of financial nature (for example, teachers' salaries), most often discussed in the literature on the quality of post-Soviet higher education [6-8], are also related to the fact that higher education has become widespread. In the early XX century, education was effectively for elites only, and there was an opportunity to provide an appropriate standard of living for professors [4].

Thus, there is an obvious contradiction between the number of students and the quality of the teaching staff. This paradox can be solved precisely by using the resource which poses difficulty [9-10].

Indeed, as emphasized above, the situation of ordinary teachers (most lecturers) and students is the same with respect to the abundance of information resources. Both have to study the same material related to up-to-date technology (for the field of information and telecommunication technologies, updates take place in real time and the programmes of lecture courses are often outdated within two to three years).

Consequently, there is an opportunity to convert the process of students studying new material into their creation of textbooks (under the guidance of the teacher, of course). It is quite possible to imagine an option when undergraduates studying in scientific and pedagogical Master's courses are preparing to update the existing textbooks for the bachelor's degree. Such activities can be carried out within the framework of assignments in specific disciplines, the teaching of which is carried out in the Master's programmes.

Moreover, there is every reason to argue that the updating of textbooks for undergraduates fits into the logic of the project activities of postgraduate students. Recall that currently in the post-Soviet space project activity is considered as one of the most promising forms of training. In particular, in the literature [11,12] there is such a term as "knowledge triangle", it implies a certain modernization [13] of the Humboldt principle, implying the unity of the actual training, research and project activities, combined in the educational process.

However, to put before the students the tasks associated with the performance of their projects with real practical (and moreover, commercial) value is difficult. In modern conditions, the commercialization of the results of scientific and technical activities carried out even by full-time University teachers is at a very low level. The number of developments implemented in practice in Kazakhstan does not exceed a fraction of a percent of the total number of conducted scientific and technical research, i.e. the vast majority of publications related to engineering and technology do not find practical application. It is obvious that in such conditions the practical significance of projects aimed at creating technical innovations by postgraduates will be even lower.

Therefore, it makes sense to consider other areas of project activities of postgraduates. It is possible that the creation of textbooks for undergraduate may be its most promising (at least in terms of mass coverage) form.

The prospects of this form of project activity for students associated with the resolution of the contradiction between the quality of education and the mass character of higher education, which was mentioned above.

## 5. LECTURER AND DISTANCE LEARNING

Distance learning aimed at the widest possible use of video lectures (in the future – artificial intelligence systems) can serve as another tool for resolving the contradiction stated above. We emphasize that from the positions advocated in this work, artificial intelligence systems are considered not as a "replacement" of the teacher with an information product, but as a means of increasing the number of University students per teacher. This approach, among other things, fits into the logic of the strategy for the development of artificial intelligence systems, developed in [14].

This approach, in particular, meets the interests of universities, as it allows significant reduction in the cost of labor of the teaching staff while maintaining the quality of education.



In a sense, we are talking about the creation of an “autocatalytic” system, when education at the University is driven by the students themselves in accordance with principles of modern pedagogy applied in Anglo-Saxon universities.

The first step towards the introduction of such an “autocatalytic” system can be to provide support for video lectures for undergraduate students. The role of the teacher in this case is reduced to curatorial activities, which significantly reduces the labor costs of providing a course of lectures on each individual discipline.

In other words, at the first stage of implementation of the proposed approach, we can offer the following scheme of the educational process in the undergraduate:

The primary phase is the preparation of educational material on specific undergraduate courses in the form of video lectures. Secondly, the students will perform the task of searching for additional material for these lectures. Specifically, we are referring to the creation of additional training tools such as animations and other illustrative materials created with the help of modern computer graphics.

Similarly, it is possible to raise the question of creating information resources that will provide practical training in the bachelor’s degree by undergraduates.

In this case, the role of the teacher (Professor) is reduced to supervising the relevant activities, providing guidance and oversight, suggesting novel directions and ideas, etc.

It is appropriate to emphasize that the performance of such tasks by undergraduates will deepen their knowledge and consolidate the material that they studied earlier (especially since, as the current practice shows, it remains unused, quickly forgotten).

This, of course, requires a certain modernization of the existing approaches to teaching in the scientific and pedagogical postgraduate courses, which has long been overdue. Namely, current Master’s dissertations, particularly in technical disciplines, are in their overwhelming majority unusable. This is due, among other things, to the fact that in modern conditions it is extremely difficult to provide real practical use of the results obtained during the implementation of Master’s dissertations. Much more useful (from all points of view) would be the creation of appropriate teaching materials for undergraduate.

## 6. CONCLUSION

Thus, at present, there are all prerequisites to reconsider the role and functions of the teacher of a modern University.

It is advisable to examine the possibility of transferring the educational process in universities to an “autocatalytic” mode, when the educational process is largely supported by the students themselves (in particular, postgraduates provide support for video lectures and information resources for practical training in the undergraduate programmes). The modern level of development of information technologies allows this to be done without reducing the quality of education (on the contrary, the quality of the lecture material will increase, as the prerequisites for the identification and elimination of incompetent teachers, the number of which in modern Kazakh universities remains unacceptably large).

In this case, the role of the Professor is reduced to curatorial functions, which allows one to free up time for science classes, leading the workload to those indicators that were characteristic of University education.

## REFERENCES

- [1] I.E. Suleimenov, O.A. Gabrielyan, Z.Z. Sedlakova and G.A. Mun, *History and philosophy of science*, Almaty: Kazakh University, 2018, p. 406.
- [2] T.O. Kochetkova, M.V. Noskov and V.A. Shershneva, “Universities in Germany: from Humboldt reform to Bologna process”, *J. Higher education in Russia*, vol. 3, 2011, pp.137-142.
- [3] G. Duda, *Introduction to the Memorandum by Wilhelm von Humboldt. J. University administration: practice and analysis*, vol.6, 1998, pp. 24-27.
- [4] A.V. Shipilov, “Salary of Russian Professor in her present, past and future”, *J. ALMA MATER: Higher school Herald*, vol.4, 2003, pp. 33-42.
- [5] The Ministry of National Education, *Reign Of Emperor Nicholas I (1825-1839)*, St. Petersburg, book edition: a Collection of judgments, 2nd edition, pp. 756. (<http://elib.shpl.ru/ru/nodes/8580-t-2-tsarstvovanie-imperatora-nikolaya-i-1825-1855-god-otdelenie-1-e-1825-1839-god-1875#mode/inspect/page/9/zoom/4>)
- [6] S. V. Hmelevsky, About priceless “National heritage of Russia”, or on the question of provision of positive development of domestic system of education and science”, *J. Social and Political Sciences* vol.3, 2013, pp.25-34. (<https://docplayer.ru/51475515-Hmelevskiy-s-v-o-bescennom-nacionalnom-dostoyanii-rossii-2-politologiya.html>)



- [7] G. N. Dolenko and I. G. Dolenko, "Problems of feminization in Russia", *J. Problems of modern science and education*, vol.4, 2013, pp. 142-144.
- [8] V. G. Khalin, "Effective Professor contract: carrot or stick: carrot or stick?", *J. Problems of Governance*, vol.7, no.11, 2014, pp.28-42.
- [9] A. Gin, A. Kudryavtsev, V. Bubentsov and A. Seredinsky, "Theory of inventive problem solving", Litres, 2018. (<https://www.labirint.ru/books/579090/>)
- [10] E. N. Galkina, "The use of elements of the theory of inventive problem solving in the educational process in higher education", *J. World of science*, vol.5, no.1, 2017, P.21. (<https://mir-nauki.com/PDF/22PDMN117.pdf>)
- [11] T. G. Kalinovskaya, S. A. Kosolapova and A.V. Proshkin, "The Knowledge Triangle as a factor of innovative development", *J. Modern science-intensive technologies*, vol.10, 2010, pp. 118-120.
- [12] W. Maximilian and P. Wolfgang, "Triangle of knowledge" between the spheres of science, education and innovation: conceptual discussion, *J. Foresight and STI Governance*, vol.11, no.2, 2017. pp.10-26. (<https://foresight-journal.hse.ru/2017-11-2/207098236.html>)
- [13] I.E. Suleimenov, O.A. Gabrielyan, V. Buryak, N. Safonov, G.S. Irmuhametova, S. B. Kardashev and G.A. Mun, "Organization and planning of scientific research", Almaty: Kazakh University, 2018, P.336 .
- [14] M. N. Kalimoldayev, I.T. Pak, S.T. Baipakbayeva, G.A. Mun, D.B. Shaltykova and I.E. Suleimenov, "Methodological basis for the development strategy of the artificial intelligence systems in the Republic of Kazakhstan", *News of the national academy of sciences of the Republic of Kazakhstan. Series of geology and technical sciences*, vol.5, no. 431, 2018, pp. 47 – 54.