

Systematicity of students' independent work in cloud learning environment

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Abstract. The paper deals with the problem of out-of-class students' independent work in information and communication learning environment based on cloud technologies. Results of appropriate survey among students of pedagogical university are discussed. The students answered the questions about systematicity of their learning activity and propositions for its improving. It is determined that the leading problems are needs in more careful instruction according to features of the task completing, insufficient experience in self-management, the lack of internal motivation. Most of all, students recommend to provide the tasks with detail instruction (oral or written) and to pay attention to careful planning the time that is necessary for full completion of the task. It is pointed that such complicated requirements can be satisfied only by complex use of information and communication technologies as well as the automated system of pedagogical diagnostics. Some requirements for management of students' out-of-classroom independent work are formulated as a result of this discussion.

Keywords: students, independent work, cloud environment, systematicity.

1 Introduction

Cloud technologies is a basis of modern distance learning. It provides the students with possibility of study that is free in space and time. Students of full time learning also use the cloud pedagogical information and communication environment for out-of-classes independent work. But learning activities in cloud environment essential differs from traditional work in classroom or homework with short-term tasks. It also differs from learning work on large study projects. New kind of learning activity requires in new studies of pedagogical science in the field of didactical and psychological peculiarities of students' independent work.

Problems of educational activity in cloud environment were analyzed in studies of Liudmyla I. Bilousova [4], Valerii Yu. Bykov [10], Arnold E. Kiv [62], Hennadiy M. Kravtsov [31], Mykhailo S. Lvov [69], Yevhenii O. Modlo [43], Pavlo P. Nechypurenko [47], Maia V. Popel [38], Serhiy O. Semerikov [72], Aleksander V. Spivakovsky [14], Andrii M. Striuk [39], Illiia O. Teplytskyi [63] and others. The other side of investigations is devoted to the pedagogical theory of students' independent work management. Oleksandr V. Malykhin [36] is an author of one of the recent fundamental research, specifically oriented on the problems of management of students' independent work, he suggests a model of the system of management of the students' independent learning activity in pedagogical university as well as the corresponded pedagogical technology, which has been tested at foreign language learning.

The basis of effective management of students' independent learning activities in higher education institutions is the study of the didactical conditions of management of students' independent work both theoretically and by means of a questionnaire [29, 64, 66]. Thus, according to [64] it is determined that third-year students during independent work had such difficulties as unclear requirements, lack of special literature, the discrepancy tasks with the subject of the course. The results of survey of students on the use of information technologies during independent work [42] are interesting for understanding the technique of students' work. As a result of this survey, students mostly use lecture summaries and electronic resources rather than textbooks or other teaching materials [42] in process of their self-preparation for classes. Survey method was used to determine the problems of self-study of primary school teachers in Luhansk Taras Shevchenko National University [53]. By results of [53], students often identify such difficulties, when performing independent work: not enough books (not enough information on the Internet), objectives or requirements are unclear, lack of time, trouble finding information, too large amount of information that makes it difficult to study. Survey [6], which deals with the problems of management of the students' independent work in the information and communication pedagogical environment, show that students widely use Internet resources during independent work, but they do it spontaneously and do not obtain proper effect on the success of learning. So management of independent work should be provided special means in information and communication environment, aimed at improving the efficiency of the use of Internet resources during independent work of students [6].

The author of [28] took attention for the level of cognitive students'

activity in process of independent work and suggested the appropriate system of tasks for independent work on educational discipline “Method of teaching informatics”. These tasks are focused on productive and creative activities of students and anticipate their implementation in the Moodle system. The author underlines that the most positive results were achieved by students, who are characterized by a high and average level of cognitive activity and a certain experience of independent work in pedagogical information and communication environment [28].

Despite the considerable interest of researchers to pedagogical conditions of students' independent work, the problem of empirical research of relations between factors, which determine the effectiveness of independent learning activities is still not exhausted. In particular, one of the actual problems in management of students' independent work in pedagogical information and communication environment is providing the systematicity of such activity. The lack of direct personal contact between student and teacher as well as the lack of personal connections between students during the task execution and presentation of its results needs an innovative approach for motivation and help that traditionally provides the learning process.

Objectives of this paper is the analysis of pedagogical conditions of providing the systematic learning activity of students' in pedagogical information and communication environment.

2 Theoretical background

On the basis of the analysis of psychology and pedagogical scientific works, it has been established that independent work of students is a multi-faceted concept and involves various aspects of its research: as a teaching method (Vladislav B. Bondarevskii [7], Volodymyr K. Buriak [9], Ivan I. Kobylatckii [27], Leonid I. Ruvinskii [59], etc.); as a type of activity (Evgenii K. Bortkevich [8], Mykhailo D. Kasianenko [25], Vitalii A. Kozakov [30], Olena O. Lavrentieva [34], Osvald A. Nilson [48], Ravil A. Nizamov [49], Liubomyr M. Okhrymovych [50], Gennadii P. Semanov [61], Mykola P. Skakun [67], etc.); as a form of organization of the educational process (Boris P. Esipov [16], Ilia I. Iliasov [21], Valentina Ia. Liaudis [35], Aleksandr G. Molibog [44], etc.); as a learning tool (Sergei I. Arkhangelskii [1], Malla G. Garunov [19], Galina N. Kulagina [32], Pavel I. Pidkastyi [52], Valentin I. Tolkunov [74], etc.). In our study, independent work is considered as an activity of a student, which takes place without the direct involvement of the teacher, but is directed and guided by him.

Studying the problem of management of independent work of students

involves, first of all, the identification of the essence of management, clarification of his role in the student's educational activities. It was defined on the basis of works of Vladimir P. Bespalko [2], Tatiana A. Dmitrenko [12], Larysa V. Filippova [17], Valerii A. Iakunin [23], Lev B. Itelson [24], Aelita K. Markova [37], Raushan K. Mashanova [40], Valerii Ia. Nechaev [46], Liudmila V. Rychkova [60], Kateryna V. Yaresko [13] and others that the essence of management consists in the implementation of the interaction of the student and the teacher, aimed at activating the student's activities in the learning process and at achieving the goal. As a result of this interaction, the socio-cognitive experience of the student changes. Depending on the nature of the teacher's influence on the student's independent work, the types of management are distinguished:

1. according the distribution of roles in the management between the subjects of the educational process — direct management, co-management and self-management;
2. by the presence of feedback — with feedback and without feedback; by the degree of individualization of influence — directed and dispersed; by level of using technical equipment — manual and automated.

From the standpoint of a cybernetic approach, the management is a process that is carried out in the following stages: collecting information and evaluating the situation; setting objectives; decision-making on choosing the appropriate method of solving the problem; realization of the decision; control and evaluation of results; adjustment. Each stage has a specific purpose and task assignments, provides for certain actions of the management entity.

A teacher can provide personal interaction with students to manage their independent work only, when students' independent work is in progress in classroom. The management of out-of-classroom learning activity in traditional study is based on preliminary instructing, didactical tools and student's experience in self-management of own learning activity. Such situation leads to the lack of creative and productive activity in students' out-of-class study, because teachers have problems with management of such activity by traditional means. Only using the innovation pedagogical technologies, based on information and communication learning environment and cloud technologies, gives us possibility to realize on-line management of students' independent work at distance.

The development of information and communication technologies, particular cloud technologies, creates the prerequisites for improving

the efficiency of management of students' independent work. A number of scientific works is devoted to the didactic aspects of the use of ICT in independent work of students (Liudmyla I. Bilousova [6], Andrei P. Ershov [15], Boris S. Gershunsky [20], Liudmyla E. Gryzun [3], Yurii V. Horoshko [22], Aleksandr A. Kuznetcov [33], Yukhym I. Mashbyts [41], Vadim M. Monakhov [45], Nataliia M. Omelchenko [51], Viktor N. Pustovoitov [54], Serhii A. Rakov [55], Yurii S. Ramskyi [26], Vasili G. Razumovskii [56], Yuliia P. Reva [57], Irena V. Robert [58], Vitalii V. Rubtcov [11], Vladimir F. Sholokhovich [65], Tetiana V. Solodka [68], Iryna V. Synelnyk [71], Nina F. Talyzina [73], Aleksandr Iu. Uvarov [75], Myroslav I. Zhaldak [18], and others). In these studies, attention is paid to the disclosure of new forms of educational and cognitive activity of students with the use of information and communication technologies. The analysis makes it possible to put forward a hypothesis about expediency of computer-oriented management of independent work of students in the process of teaching disciplines of the natural-mathematical cycle.

3 Empirical research

To determine the leading problems, which impede students' independent work, we suggested them some questionnaire with a multiple choice (see Table 1). The target group are students of pedagogical university — future teachers. The size of the sample is 53.

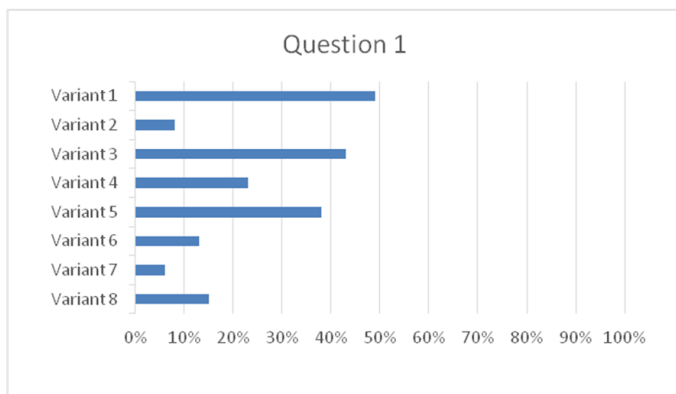


Fig. 1. Percentage of students' choice according to Question 1 (see Table 1)

Table 1. Questionnaire

Question	Variant	
Question 1. Sometimes it is difficult to complete a training task at the appointed time, the reason for this is often the following circumstances:	1	there is no enough understanding of how to complete a task
	2	there are other more important things
	3	there was a mistake in planning time, the task have been left for the last day and time was not enough
	4	bad health, illness
	5	the task is not of interest, it is difficult to force itself to borrow it, even if necessary
	6	fulfilling the task does not affect the achievement of my life goals (does not give the experience that will be needed in life)
	7	the task does not affect my grades at the university (the evaluation system does not take into account the results of this task)
	8	the task is so complicated (labor-intensive) that it is not possible to execute it
Question 2. To improve the systematicity of students' work , I would recommend teachers:	1	not to give for independent work of creative tasks, the order of execution of which is not known in advance
	2	not to give for the independent work of tasks of a reproductive nature, which is not interesting to perform
	3	to provide a detailed written instruction to complete the tasks
	4	to conduct oral consultations and demonstrations in relation to the execution of tasks
	5	to reduce the grading score for the violation of the term of the tasks
	6	to provide multiple reminders about the near deadline of the results presentation, using the means of communication
	7	to calculate the time on the task carefully

The question 1 suggests to the students some hypothetical “opinions” that characterize probable problems, connected with quality and fullness of preliminary instructing, motivation and cognitive interest, students’ experience in self-management of independent work. The answers show

(see Fig. 1) that the leading problems are needs in more careful instruction according to features of the task completing, insufficient experience in self-management, the lack of internal motivation. Statistical analysis shows that influence of variants 2, 6, 7, 8, on the systematicity of independent learning activity is significantly less than the above factors (significance level 0.01 according to Pearson's criterion Chi-square). We should take into account the variant 4 also, because of importance of health problems for a student as a person.

The same problems were analyzed by students during answering Question 2 from the other viewpoint (see Table 1 and Fig. 2). Most of all, students recommend to provide the tasks with detail instruction (oral or written) and to pay attention to careful planning the time that is necessary for full completion of the task. Other variants (1, 2, 5, 6) were chosen significantly less (significance level 0.01 according to Pearson's criterion Chi-square).

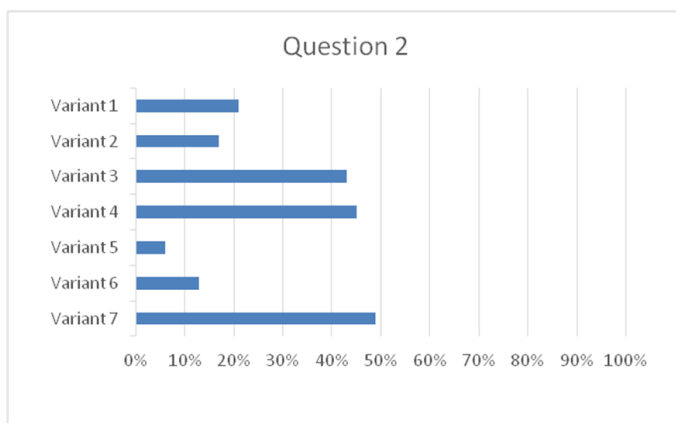


Fig. 2. Percentage of students' choice according to Question 1 (see Table 1)

Such answers of Question2 confirm the answers on Question 1 (Variants 1 and 4), but are in conflict with variant 5 of Question 1. To increase the cognitive interest of the task we should suggest creative tasks for the students, but such tasks are difficult. If the preliminary instructions are very detailed — we'll lost the creative component in the task. So detail instruction should be provided only in needs in time. This instruction should be individual for the student. One teacher cannot serve all students of academic group in such regime, so we need to organize the collective

work of students in information and communication learning environment. We need to use the automated system of pedagogical diagnostics for control every student activity and providing him with context help [5]. There are experimental researches [70] and theoretical studies [10] that stress an attention on accordance between student's learning styles and the used method of teaching, "... the way the material presented in online electronics course" [70]. So the automated pedagogical diagnostic system should be comprehensive enough to determine appropriate student's characteristics.

As a result of this discussion let us to formulate some requirements for management of students' out-of-classroom independent work:

- availability of information and communication learning environment which is useful for students;
- students experience in self-management of own learning activity — this experience is provided by systematic independent work, which step by step transforms from direct management by teacher through co-management with a teacher to self-management according to objectives, plan, system of learning tools and recommendations from teachers and the automated system of pedagogical diagnostics;
- creative elements in the system of learning tasks;
- students' cooperation and communication in process of independent work that increases motivation, helps to follow the time plan and to overcome problems;
- availability of the automated system of the pedagogical diagnostics that provides a student with help in pedagogical design of his learning activity;
- careful design of the system of learning tasks individually for each student with time planning.

4 Conclusions

1. As a result of survey among students of pedagogical university, the most common problems in systematicity of learning activity during the independent work of the student are the lack of instructions, the lack of cognitive interest, students' mistakes in self-management of own learning activity, teachers' mistakes in time planning for the systems of learning tasks for students' independent work.
2. Some requirements for management of students' independent work for fixing these problems are suggested:

- information and communication learning environment should be available and useful for students;
- students should continuously capture the experience in self-management of own learning activity;
- the system of learning tasks should assume elements for creative students' learning activity;
- students' cooperation and communication in process of independent work should increase motivation, help to follow the time plan and overcome problems;
- the automated system of the pedagogical diagnostics should be worked out to provides a student with help in pedagogical design of his learning activity;
- design of the system of learning tasks should be individual for each student and assume accurate time planning.

References

1. Arkhangel'skii, S.I.: *Uchebnyi protsess v vysshei shkole, ego zakonomernye osnovy i metody* (The educational process in higher education, its regular principles and methods). Vysshaia shkola, Moscow (1980).
2. Bepalko, V.P.: *Kiberpedagogika = Cyberpedagogy: vvedenie v teoriu i metodologiiu pedagogicheskogo obespecheniia kompiuternogo obucheniiia* (Cyberpedagogy: an introduction to the theory and methodology of pedagogical computer software). Narodnoe obrazovanie, Moscow (2018).
3. Bilousova, L., Gryzun, L., Zhytienova, N., Pikalova, V.: Search algorithms learning based on cognitive visualization. In: Ermolayev, V., Mallet, F., Yakovyna, V., Mayr, H.C., Spivakovsky, A. (eds.) *Proceedings of the 15th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer (ICTERI, 2019)*, Kherson, Ukraine, June 12–15 2019, vol. I: Main Conference. CEUR Workshop Proceedings 2387, 472–478. <http://ceur-ws.org/Vol-2387/20190472.pdf> (2019). Accessed 30 Jun 2019.
4. Bilousova, L., Kolgatin, O., Kolgatina, L.: Computer Simulation as a Method of Learning Research in Computational Mathematics. In: Ermolayev, V., Mallet, F., Yakovyna, V., Kharchenko, V., Kobets,

- V., Kornilowicz, A., Kravtsov, H., Nikitchenko, M., Semerikov, S., Spivakovsky, A. (eds.) Proceedings of the 15th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer (ICTERI, 2019), Kherson, Ukraine, June 12–15 2019, vol.II: Workshops. CEUR Workshop Proceedings 2393, 880–894. http://ceur-ws.org/Vol-2393/paper_209.pdf (2019). Accessed 30 Jun 2019.
5. Bilousova, L., Kolgatin, O., Kolgatina, L.: Pedagogical Diagnostics with Use of Computer Technologies. In: Ermolayev, V., Mayr, H. C., Nikitchenko, M., Spivakovsky, A., Zholtkevych, G., Zavileysky, M., Kravtsov, H., Kobets, V., Peschanenko, V. (eds.) Proceedings of the 9th International Conference on ICT in Education, Research and Industrial Applications: Integration, Harmonization and Knowledge Transfer, Kherson, Ukraine, June 19–22, 2013. CEUR Workshop Proceedings 1000, 209–220. <http://ceur-ws.org/Vol-1000/ICTERI-2013-p-209-220.pdf> (2013). Accessed 21 Nov 2018.
 6. Bilousova, L. I., Kolgatin, O. G., Kolgatina, L. S.: Diagnosis of problems of management of the students' independent work in the information and communication pedagogical environment. *Information Technologies in Education* 20, 7–12 (2014). doi:10.14308/ite000492
 7. Bondarevskii, V.B.: *Izuchenie i razvitie interesov i sklonnostei uchashchikhsia starshikh klassov k otdelnym predmetam shkolnogo obucheniia (v sisteme uchebnykh zaniatii)* (The study and development of the interests and inclinations of high school students to individual subjects of school education (in the system of instruction)). Dissertation, Scientific research institute of theory and history of pedagogy (1960).
 8. Bortkevich, E.K.: *Samostoiatelnaia rabota kursantov voennykh uchilishch po sotcialno-ekonomicheskim distsiplinam* (Independent work of cadets of military schools in socio-economic disciplines). Dissertation, Leningrad State Pedagogical Institute named after A. I. Herzen (1950).
 9. Buriak, V.K.: *Teoriia i praktika samostoiatelnoi uchebnoi raboty shkolnikov: na materialakh estestvennonauchnykh distciplin* (Theory and practice of independent educational work of schoolchildren: on the materials of natural science disciplines). Dissertation, Krivoi Rog State Pedagogical Institute (1986).
 10. Bykov, V. Yu.: *Models of the open education organizational systems*. Atika, Kyiv (2009).

11. Davydov, V. V., Rubtsov, V. V., Kritckii, A. G.: *Psikhologicheskie osnovy organizatsii uchebnoi deiatelnosti, oposredstvovannoi ispolzovaniem kompiuternykh sistem* (The psychological basis for the organization of educational activities mediated by the use of computer systems). *Psikhologicheskaiia nauka i obrazovanie* 2, 68–72 (1996).
12. Dmitrenko, T. A.: *Teoreticheskie osnovy issledovaniia intensifikatsii protsessa obucheniia v vysshei shkole* (Theoretical foundations of the study of the intensification of the learning process in higher education). Prometei, Moscow (2000).
13. Dmytrenko, T. O., Yaresko, K. V.: *Kontseptsiiia orhanizatsii ta upravlinnia samostiinoiu robotoiu studentiv* (The concept of organization and management of students' independent work). *Visnyk Kharkivskoi derzhavnoi akademii kultury* 28, 183–187 (2009).
14. Ermolayev, V., Mallet, F., Yakovyna, V., Kharchenko, V., Kobets, V., Kornilowicz, A., Kravtsov, H., Nikitchenko, M., Semerikov, S., Spivakovsky, A.: Preface. In: Ermolayev, V., Mallet, F., Yakovyna, V., Kharchenko, V., Kobets, V., Kornilowicz, A., Kravtsov, H., Nikitchenko, M., Semerikov, S., Spivakovsky, A. (eds.) *Proceedings of the 15th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer (ICTERI, 2019)*, Kherson, Ukraine, June 12–15 2019, vol. II: Workshops. CEUR Workshop Proceedings 2393. <http://ceur-ws.org/Vol-2393/preface.pdf> (2019). Accessed 30 Jun 2019.
15. Ershov, A. P.: *Programmirovanie — vtoraiia gramotnost* (Programming — second literacy). Computing Center of the Siberian Branch of the Academy of Sciences of the USSR, Novosibirsk (1981).
16. Esipov, B. P.: *Samostoiatelnaia rabota uchashchikhsia na urokakh* (Independent work of students in the classroom). Uchpedgiz, Moscow (1961).
17. Filippova, L. V.: *Samostiina robota studentiv u vyshchyykh navchalnykh medychnykh zakladakh yak chynnyk profesionalizmu* (Independent work of students in the higher medical school as factor professional). *Pedahohichni nauky: teoriia, istoriia, innovatsiini tekhnolohii* 5 (7), 359–367 (2010).
18. Galdak, M., Khomik, A.: *Formuvannia informatsiinoi kultury vchytelia* (Creation of Information Culture for the Teacher). In: *Proceedings of International Symposium “Computers*

- in Europe. Past, Present and Future”, Kyiv, October 5–9, 1998. International Charity Foundation for History and Development of Computer Science and Technique (ICFCST). <http://www.icfcst.kiev.ua/Symposium/Proceedings/Galdak.doc> (1998).
19. Garunov, M. G., Pidkasisty, P. I.: Samostoiatelnaia rabota studentov (Students' independent work). Znanie, Moscow (1978).
 20. Gershunsky, B., Lozansky, E.: Russia: experience in democracy. Kontinent USA, Washington (2000).
 21. Graf, V., Piasov, I. I., Liaudis, V. Ia.: Osnovy organizatsii uchebnoi deiatelnosti i samostoiatelnaia rabota studentov (Fundamentals of the organization of educational activity and independent work of students). Izdatelstvo MGU, Moscow (1981).
 22. Horoshko, Yu. V.: Systema informatsiinoho modeliuvannia u pidhotovtsi maibutnikh uchytelev matematyky ta informatyky (The system of information modeling in the preparation of future teachers of mathematics and informatics). Dissertation, National Pedagogical Dragomanov University (2013).
 23. Iakunin, V. A.: Psikhologiiia upravleniia uchebno-poznavatelnoi deiatelnosti studentov (Psychology of management of educational and cognitive activity of students). LGU, Leningrad (1986).
 24. Itelson, L. B.: Lektcii po sovremennym problemam psikhologii obucheniiia (Lectures on the modern problems of the psychology of learning). Vladimir (1972).
 25. Kasianenko, M. D.: Samostoiatelnaia rabota studenta (Student's independent work). UMK VO, Kiev (1988).
 26. Khazina, S., Ramsky, Y., Eylon, B. S.: Computer modeling as a scientific means of training prospective physics teachers. In: 8th International Conference on Education and New Learning Technologies (EDULEARN 2016), pp. 7699–7710 (2016). doi: 10.21125/edulearn.2016.0694
 27. Kobyliatckii, I. I.: Osnovy podgotovki vysshei shkoly (Basics of higher education). Vishcha shkola, Kiev, Odessa (1978).
 28. Kolgatina, L. S.: Samostiina robota studentiv z kursu “Metodyka navchannia informatyky” (Students' independent work in course “Methods of teaching informatics”). Physical and Mathematical Education 4 (18), 76–80 (2018). doi: 10.31110/2413-1571-2018-018-4-012

29. Kotova, A. V.: Vyznachennia sutnosti ta pryntsyp orhanizatsii samostiinoi roboty z inozemnoi movy (Definition of the Essence and Principles of its Organization in the Foreign Language). Vykladannia mov u vyshchyykh navchalnykh zakladakh osvity na suchasnomu etapi. Mizhpredmetni zviazky 18, 109–116 (2011).
30. Kozakov, V. A.: Samostoiatelnaia rabota studentov i ee informatcionno-metodicheskoe obespechenie (Independent work of students and its information and methodological support). Vyshcha shkola, Kharkov (1990).
31. Kravtsov, H. M., Gnedkova, O. G.: Methods of using cloud services in foreign language training. In: Semerikov, S. O., Shyshkina, M. P. (eds.) Proceedings of the 5th Workshop on Cloud Technologies in Education (CTE 2017), Kryvyi Rih, Ukraine, April 28, 2017. CEUR Workshop Proceedings 2168, 54–65. <http://ceur-ws.org/Vol-2168/paper8.pdf> (2018). Accessed 21 Nov 2018.
32. Kulagina, G. N.: Formirovanie u studentov vechernego otdeleniia poznatelnoi samostoiatelnosti i aktivnosti (v protsesse obuchenii na mladshikh kursakh) (Formation in students of the evening department of cognitive independence and activity (in the process of training in junior courses)). Dissertation (1980).
33. Kuznetcov, A. A., Zenkina, S. V.: Uchebnik v sostave novoi informatcionno-kommunikatsionnoi obrazovatelnoi sredi (The textbook as part of a new information and communication educational environment). Binom. Laboratoriia znaniy, Moscow (2013).
34. Lavrentieva, O. O., Rybalko, L. M., Tsys, O. O., Uchitel, A. D.: Theoretical and methodical aspects of the organization of students' independent study activities together with the use of ICT and tools. In: Kiv, A. E., Soloviev, V. N. (eds.) Proceedings of the 6th Workshop on Cloud Technologies in Education (CTE 2018), Kryvyi Rih, Ukraine, December 21, 2018. CEUR Workshop Proceedings 2433, 102–125. <http://ceur-ws.org/Vol-2433/paper06.pdf> (2019). Accessed 10 Sep 2019.
35. Liaudis, V. Ia. (ed.) Formirovanie uchebnoi deiatelnosti studentov (The formation of educational activities of students). Izdatelstvo MGU, Moscow (1989).
36. Malykhin, O. V.: Orhanizatsiia samostiinoi navchalnoi diialnosti studentiv vyshchyykh pedahohichnykh navchalnykh zakladiv: teoretyko-metodolohichniy aspekt (Management of the independent learning activity of students of pedagogical higher educational institutions:

- theoretical-methodological aspect). Vydavnychiy dim, Kryvyi Rih (2009).
37. Markova, A. K.: Formirovanie motivatsii ucheniia v shkolnom vozraste: posobie dlia uchitelia (Formation of the motivation of learning at school age: a manual for the teacher). Prosveshchenie, Moscow (1983).
 38. Markova, O., Semerikov, S., Popel, M.: CoCalc as a Learning Tool for Neural Network Simulation in the Special Course “Foundations of Mathematic Informatics”. In: Ermolayev, V., Suárez-Figueroa, M. C., Yakovyna, V., Kharchenko, V., Kobets, V., Kravtsov, H., Peschanenko, V., Prytula, Ya., Nikitchenko, M., Spivakovsky A. (eds.) Proceedings of the 14th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer (ICTERI, 2018), Kyiv, Ukraine, 14–17 May 2018, vol. II: Workshops. CEUR Workshop Proceedings 2104, 338–403. http://ceur-ws.org/Vol-2104/paper_204.pdf (2018). Accessed 30 Nov 2018.
 39. Markova, O. M., Semerikov, S. O., Striuk, A. M., Shalatska, H. M., Nechypurenko, P. P., Tron, V. V.: Implementation of cloud service models in training of future information technology specialists. In: Kiv, A. E., Soloviev, V. N. (eds.) Proceedings of the 6th Workshop on Cloud Technologies in Education (CTE 2018), Kryvyi Rih, Ukraine, December 21, 2018. CEUR Workshop Proceedings 2433, 499–515. <http://ceur-ws.org/Vol-2433/paper34.pdf> (2019). Accessed 10 Sep 2019.
 40. Mashanova, R. K.: Sovershenstvovanie upravleniia samostoiatelnoi uchebnoi raboti studentov na osnove sistemnoi organizatscii ee kontroliia (na materiale tekhnicheskikh vuzov) (Improving the management of independent educational work of students on the basis of systemic organization of its control (on the material of technical universities)). Dissertation, Kievskii gosudarstvennyi universitet imeni T. G. Shevchenko (1990).
 41. Mashbitc, E. I.: Psikhologicheskie osnovy upravleniia uchebnoi deiatelnosti (Psychological foundations of the management of educational activities). Dissertation, NII obshchei i pedagogicheskoi psikhologii APN SSSR (1989).
 42. Mitriasova, O. P.: Suchasni informatsiini tekhnolohii u praktytsi navchannia vshchoi shkoly (Modern information technologies in practice of training of the higher school). Pedahohichni nauky: teoriia, istoriia, innovatsiini tekhnolohii 6 (32), 375–383 (2013).

43. Modlo, Ye. O., Semerikov, S. O.: Xcos on Web as a promising learning tool for Bachelor's of Electromechanics modeling of technical objects. In: Semerikov, S. O., Shyshkina, M. P. (eds.) Proceedings of the 5th Workshop on Cloud Technologies in Education (CTE 2017), Kryvyi Rih, Ukraine, April 28, 2017. CEUR Workshop Proceedings 2168, 34–41. <http://ceur-ws.org/Vol-2168/paper6.pdf> (2018). Accessed 21 Nov 2018.
44. Molibog, A. G.: Osnovy nauchnoi organizatscii uchebnogo truda studentov (Fundamentals of scientific organization of educational work of students). BPI, Minsk (1975).
45. Monakhov, V. M.: Razrabotka prognosticheskoi modeli razvitiia teorii obucheniia dlia IT-obrazovaniia (Building of the prognostic model of development of the theory of teaching for IT-education). *Sovremennye informatsionnye tekhnologii i IT-obrazovanie* 13 (2), 111–121 (2017).
46. Nechaev, V. Ia.: Predmetnaia oblast sotciologii obrazovaniia: metodologicheskie i teoreticheskie predposylki (The subject area of the sociology of education: methodological and theoretical prerequisites). Dissertation, Moscow State University (1993).
47. Nechypurenko, P. P., Semerikov, S. O.: VlabEmbed — the New Plugin Moodle for the Chemistry Education. In: Ermolayev, V., Bassiliades, N., Fill, H.-G., Yakovyna, V., Mayr, H. C., Kharchenko, V., Peschanenko, V., Shyshkina, M., Nikitchenko, M., Spivakovsky, A. (eds.) 13th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer (ICTERI, 2017), Kyiv, Ukraine, 15–18 May 2017. CEUR Workshop Proceedings 1844, 319–326. <http://ceur-ws.org/Vol-1844/10000319.pdf> (2017). Accessed 21 Mar 2019.
48. Nilson, O. A.: Teoriia i praktika samostoiatelnoi raboty uhashchikhsia: Issledovanie roli samostoiat. raboty uhashchikhsia v uchebnom protsesse i ee effektivnosti pri ispolzovanii rabochikh tetradei v shkolakh ESSR (Theory and practice of students' independent work: Study of the role of students' independent work in the educational process and its effectiveness when using workbooks in schools of the ESSR). Valgus, Tallinn (1976).
49. Nizamov, R. A.: Didakticheskie osnovy aktivizatscii uchebnoi deiatelnosti studentov (Didactic bases of activation of educational activity of students). Izdatelstvo Kazanskogo universiteta, Kazan (1975).

50. Okhrymovych, L., Shved, M., Hrebenyk, M.: Meta, struktura i sut samostiinoho vyvchennia farmakoterapii (The purpose, structure and essence of independent study of pharmacotherapy). In: *Novi tekhnolohii navchannia v medychnomu vyshchomu navchalnomu zakladi: Navchalno-metodychna konferentsiia*, pp.122–129. Ukrmedknyha, Ternopil (2000).
51. Omelchenko, N. M., Voinalovych, N. M.: Samostiina robota starshoklasnykiv z matematyky v umovakh dyferentsiinoho navchannia (Independent work of senior pupils on mathematics in the conditions of differentiated education). *Naukovi zapysky molodykh uchenykh* 2. <https://phm.cuspu.edu.ua/ojs/index.php/SNYS/article/view/1533> (2018). Accessed 31 Dec 2018.
52. Pidkasystyi, P. I.: Protcess i struktura samostoiatelnoi deiatelnosti uchashchikhsia v obuchenii (The process and structure of students' independent activities in learning). Dissertation, Moskovskii gosudarstvennyi pedagogicheskii institut imeni V. I. Lenina (1974).
53. Pochynkova, M. M.: Problemy orhanizatsii samostiinoi roboty filohichnoho spriamuvannia dlia studentiv — maibutnykh uchyteliv pochatkovykh klasiv (Challenges in organizing individual work of philology students — prospective primary school teacher). *Naukovyi visnyk Donbasu* 2(22). <http://nvd.luguniv.edu.ua/archiv/NN22/13pmmupk.pdf> (2013). Accessed 21 Nov 2018.
54. Pustovoitov, V. N.: Integrativno-sinergeticheskii podkhod v issledovanii razvitiia poznavatelnoi samostoiatelnosti starsheklassnikov (Integrative-synergetic approach to the study of the development of cognitive independence of high school students). *Kursiv*, Briansk (2009).
55. Rakov, S. A.: Matematychna osvita: kompetentnisnyi pidkhid z vykorystanniam IKT (Mathematical education: a competency approach using ICT). *Fakt*, Kharkiv (2005).
56. Razumovskii, V. G. (ed.) *Problemy kompiuternogo obuchenii* 2. *Znanie*, Moscow (1986).
57. Reva, Iu. F.: Didakticheskie usloviia effektivnogo ispolzovannia kompiuterov v samostoiatelnoi rabote shkolkiv (The didactic conditions for the effective use of computers in the independent work of schoolchildren). Dissertation, Kryvyi Rih State Pedagogical Institute (1994).

58. Robert, I. V. *Teoriia i metodika informatizatsii obrazovaniia: psikhologo-pedagogicheskii i tekhnologicheskii aspekty* (Theory and methods of informatization of education: psychological, pedagogical and technological aspects). Binom. Laboratoriia znaniia, Moscow (2014).
59. Ruvinskii, L. I.: *Samovospitanie lichnosti* (Self-education of personality). Mysl, Moscow (1984).
60. Rychkova, L. V.: *Korpusnye tekhnologii v razvitii poznavatelnoi aktivnosti inostrannykh studentov, izuchaiushchikh russkii iazyk v Respublike Belarus* (Case technologies in the development of cognitive activity of foreign students studying Russian in the Republic of Belarus). In: Pustoshilo, E. P. (ed.) *Materialy XV Iubileinoi Resp. nauch.-prakt. konf. "Iazyk. Obschestvo. Meditsina" i XII nauch.-prakt. seminara "Obrazovatelnye tekhnologii v obuchenii RKI (iazykam)"*, 29 okt. 2015 g., Grodno, pp. 364–367.
61. Semanov, G. P. (ed.): *Samostoiatelnaia rabota uchashchikhsia na uroke v 1–4 klassakh: sbornik statei v pomoshch uchiteliiu 1–4 klassov* (Students working independently in a lesson in grades 1–4: collection of articles to help a teacher in grades 1–4). Perm (1963).
62. Semerikov, S. O., Tepytskyi, I. O., Yechkalo, Yu. V., Kiv, A. E.: *Computer Simulation of Neural Networks Using Spreadsheets: The Dawn of the Age of Camelot*. In: Kiv, A. E., Soloviev, V. N. (eds.) *Proceedings of the 1st International Workshop on Augmented Reality in Education (AREdu 2018)*, Kryvyi Rih, Ukraine, October 2, 2018. *CEUR Workshop Proceedings 2257*, 122–147. <http://ceur-ws.org/Vol-2257/paper14.pdf> (2018). Accessed 30 Nov 2018.
63. Semerikov, S. O., Tepytskyi, I. O., Yechkalo, Yu. V., Markova, O. M., Soloviev, V. N., Kiv, A. E.: *Computer Simulation of Neural Networks Using Spreadsheets: Dr. Anderson, Welcome Back*. In: Ermolayev, V., Mallet, F., Yakovyna, V., Kharchenko, V., Kobets, V., Kornilowicz, A., Kravtsov, H., Nikitchenko, M., Semerikov, S., Spivakovsky, A. (eds.) *Proceedings of the 15th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer (ICTERI, 2019)*, Kherson, Ukraine, June 12–15 2019, vol. II: Workshops. *CEUR Workshop Proceedings 2393*, 833–848. http://ceur-ws.org/Vol-2393/paper_348.pdf (2019). Accessed 30 Jun 2019.
64. Shcherbiak, Yu. A.: *Orhanizatsiia samostiinoi roboty maibutnikh ekonomistiv u vyshchykh navchalnykh zakladakh* (Organization

- of future economists' independent study in higher educational establishments). *Naukovyi visnyk Kremenetskoho oblasnoho humanitarno-pedahohichnoho instytutu im. Tarasa Shevchenka, Ser. Pedahohika* 2, 44–52 (2013).
65. Sholokhovich, V. F.: *Didakticheskie osnovy informatsionnykh tekhnologii obuchenii v obrazovatelnykh uchrezhdeniakh* (Didactic fundamentals of information technology training in educational institutions). Dissertation, Ural State Pedagogical University (1995).
66. Shymko, I. M.: *Dydaktychni umovy orhanizatsii samostiinoi navchalnoi roboty studentiv vyshchykh pedahohichnykh navchalnykh zakladiv* (Didactic conditions of organization of independent academic work of students of the university). Dissertation, Kryvyi Rih State Pedagogical University (2002).
67. Skakun, M. P.: *Osnovy dokazovoi medytsyny — u navchalnyi protses VNZ* (The basics of evidence-based medicine — in the educational process of universities). *Medychna osvita* 2, 10–12 (2004).
68. Solodka, T. V.: *Kompiuterne testuvannia yak metod kontroliu za rezultatamy navchalnoi diialnosti studentiv* (Computer testing as a method of control over the results of students' learning activities). Dissertation, Kharkiv Pedagogical University named after H. S. Skovoroda (1995).
69. Spivakovskiy, O. V., Lvov, M. S., Kravtsov, H. M.: *Innovatsiini metody upravlinnia informatsiinymy aktyvamy vyshchoho navchalnoho zakladu* (Innovative methods of management of information assets of the university). *Kompiuter u shkoli ta simi* 3, 3–7 (2013).
70. Surjono, H. D.: The effects of multimedia and learning style on student achievement in online electronics course. *Turkish Online Journal of Educational Technology* 14 (1), 116–122. <http://www.tojet.net/articles/v14i1/14112.pdf> (2015). Accessed 21 Nov 2018.
71. Synelnyk, I. V., Zavora, V. A.: *Orhanizatsiia samostiinoi roboty studentiv z vykorystanniam informatsiino-komunikatsiinnykh tekhnolohii* (Organization of students' independent work using information and communication technologies). *Problemy ta perspektyvy formuvannia natsionalnoi humanitarno-tekhnichnoi elity* 25 (29), 191–196 (2010).
72. Syrovatskiy, O. V., Semerikov, S. O., Modlo, Ye. O., Yechkalo, Yu. V., Zelinska, S. O.: *Augmented reality software design for educational*

- purposes. In: Kiv, A. E., Semerikov, S. O., Soloviev, V. N., Striuk, A. M. (eds.) Proceedings of the 1st Student Workshop on Computer Science & Software Engineering (CS&SE@SW 2018), Kryvyi Rih, Ukraine, November 30, 2018. CEUR Workshop Proceedings 2292, 193–225. <http://ceur-ws.org/Vol-2292/paper20.pdf> (2018). Accessed 31 Dec 2018.
73. Talyzina, N. F.: Teoreticheskie problemy programmirovannogo obucheniia (Theoretical problems of programmed learning). Izdatelstvo Moskovskogo universiteta, Moscow (1969).
74. Tolkunov, V. I.: Samostoiatelnaia rabota studentov po neorganicheskoi khimii kak odno iz sredstv professionalnoi podgotovki uchitelei v pedagogicheskom institute (Independent work of students in inorganic chemistry as one of the means of professional training of teachers at a pedagogical institute). Dissertation, Moskovskii gosudarstvennyi pedagogicheskii institut imeni V. I. Lenina (1972).
75. Uvarov, A. Iu.: Na puti k tsifrovoi transformatsii shkoly (On the way to the digital transformation of the school). Obrazovanie i Informatika, Moscow (2018).