

The Analysis of Social Economic Effects of Distance Learning Technologies Implementation in Russian Regional State Universities*

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Abstract. The paper refers to the consideration reasonability of «Russian regional state universities» (RRSU) as a unique category of educational institutions. The competitive environment and their activity economic conditions are briefly described for RRSU.

The aims and directions of distance learning technologies (DLT) implementation in RRSU are analyzed from the perspectives of legal entities and individuals, including the difficult epidemiological situation in the country and the regions. DLT components implemented by RRSU are characterized.

The main directions of RRSU expenditures for DLT implementation and use in the education process are considered: procurement, implementation, server equipment, and other hardware maintenance; communication channels creation for the servers providing DLT use; different training materials and software compilation and development for DLT; tutors training or (advanced training) concerning education materials creation and to DLT practical application in the education process; ensuring of the information security necessary measures, related with DLT application in RRSU. The necessity of DLT “operational” costs is established including equipment wear compensation and education materials updating.

The structure of social-economic effects from DLT uses for RRSU directly. The items of the DLT use in foreign languages: demonstrative, educative, control-test are separately observed.

The paper states that for RRSU the expenditures for DLT implementation and application are in general profitable only if there are many students and education courses.

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1 Introduction

Russian regional state universities (RRSU) considered in the paper include universities located outside Moscow and St-Petersburg which do not have the Federal or National Research university status. In Russian, the majority of students study at RRSU. The following groups can be distinguished among them.

- (a) The Russian students from the RRSU region.
- (b) The Russian students from other regions.
- (c) Foreign students. In all three cases, the educational process can be carried out as a state-funded or a commercial-based education.

In most RRSU DLT is applied for mixed attendance mode and part-time education. Significantly, RRSU recruits its branches and subsidiaries in settlements of different regions of the Russian Federation for student quantity expansion. At the same time's foreign branches are not characteristic of RRSU. It is necessary to note the DLT's important role for RRSU the full-time students' parallel education in getting a second graduate degree at a commercial base.

RRSU activity in specialists training (advanced training) provides the successful implementation of Russian regions the social-economic development plans; their labor resources and intellectual potential preservation and increasing; expanding opportunities for innovative development, investment promotion [2]; regions economic security ensuring.

Distance learning technologies (DLT) in some cases are used by all RRSU. However in available papers «the social-economic topic», connected with DLT implementation in RRSU is not completely analyzed. So, the paper aims to eliminate the drawback.

2 RRSU Activity Conditions General Characteristic

Nowadays RRSU operates in rather difficult conditions. This is due to the need to ensure the student body for some RRSU in significant inter-university competitiveness. Concerning Russian students (full-time, mixed, or part-time mode) the main RRSU competitors are the following:

- (κ1) the leading Russian universities with the status of federal and national research universities;
- (κ2) large multidisciplinary universities of Moscow and St-Petersburg not included in the category «κ1».

Under their financial and economic capabilities under the points «κ1» and «κ2» can provide full-time students the best learning and scholarship conditions in comparison with RRSU, better job opportunities during the study period, etc. All university activities according to students of mixed-mode or part-time mode are carried out in general

with the use of DLT. At the same time, the cost of education at RRSU for such category of students is lower than at Moscow and St-Petersburg Universities.

(к3) Branches and subsidiaries of foreign universities in the regions, including commercial ones. They also attract definite students.

(к4) Universities, including in Moscow, specializing definitely or primarily in part-time education in the distance form.

(к5) Organizations providing «intermediary services» in the University applicants selection, including for DLT education – for example, <https://astrakhan.diobraz.ru/>.

Information and methodological support for RRSU branches and subsidiary activity regarding DLT use are carried out by the head organization.

According to foreign students recruiting for full-time study RRSU have the following competitors: Russian universities, mainly state universities; foreign universities from the resident country of the citizens and other countries. From the foreign citizen's perspective, RRSU has some advantages in such cases.

(a) Sending them for free education according to the “quotas” for Russian universities issued by “Rossotrudnichestvo”.

(b) For Russian-speaking citizens, living abroad firstly from post-Soviet countries. In general, DLT can be used by RRSU for foreign students tutoring permanently living abroad especially if these students know well the Russian language.

RRSU expenses for the formation and use of information resources for DLT can be restricted according to such decisions.

(r1) RRSU selection of educational materials available for free use for DLT. In some cases, it means their adaptation.

(r2) Working out barter for DLT between Universities.

(r3) Forming of mutual Internet resources by Universities (including RRSU) for their use in DLT, including resources spatial distribution. Such technologies are observed in the literature [4,6], but they are not practically used in the Russian Federation.

(r4) Distant use of “educational resources”, elaborated by the leading Russian universities, including their commercial use.

(r5) Distant implementation of educational resources of the universities specializing at DLT, including free resources (for example, www.intuit.ru).

The use of «r2...r5» variants is in general restricted by the following factors: difference in the curriculum of the definite RRSU and other universities; RRSU tutors unwillingness to re-form for “another” tutoring methods; in some cases by the significant gap in requirements for the students training level in Universities.

The directions of RRSU information and economic interaction with their external environment are represented in Fig. 1.

In the general case, RRSU can use the following components in DLT implementation.

(c1) Tasks distribution and their answers receiving in electronic form. At the same time, task distribution and answers receiving control can be automated.

(c2) The use of integrated “distance learning systems”. LMS Moodle is the most famous in Russian Universities, it has an international character. However, except LMS Moodle there are some other multiple developments for DLT, including native ones. But their analysis is not included in the paper.

(c3) Tutors and student interaction employing “group videoconferencing”.

In spring 2020 the most popular resources are the following: Zoom (www.zoom.us/signin) – it has both free and paid “service plans”; Discord (<https://discord.com/>); Microsoft Teams (<https://docs.microsoft.com/ru-ru/MicrosoftTeams/>); Google Meet (<https://gsuite.google.ru/intl/ru/products/meet/>).

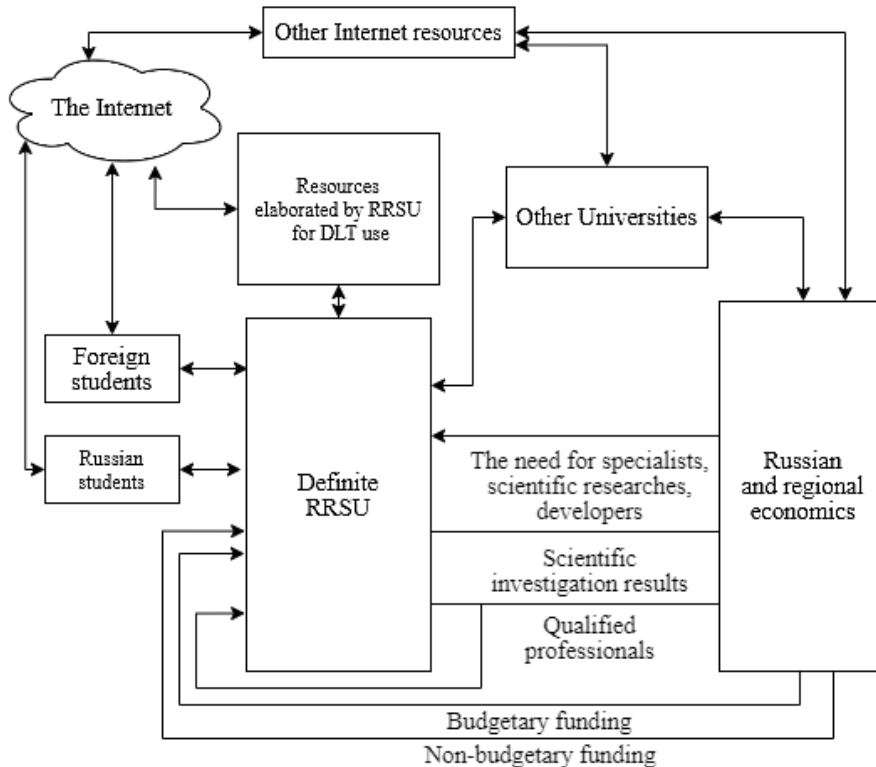


Fig. 1. The directions of RRSU interaction with an external environment.

At the same time in most cases, the software tools' free version functionality is enough for carrying out group classes with RRSU students. The indicated videoconferencing systems allow working not only with stationary users but also with mobile ones including smartphones. In this case stability and bandwidths have the principal meaning. From the information security standpoint, the consequences of the wide implementation of foreign developers' software tools in the education process have not been evaluated. Russian developers videoconferencing systems are actively advertised in the Internet: TrueConf (<https://trueconf.ru/>); Video.telphin.ru (Video.telphin.ru); Polycom studio (polycom.audiosite.ru); Videograce (<https://videograce.com/ru/>) and others.

(c4) two-way audio and video communication of the tutor with one student. The most popular ST for this purpose is Skype (www.skype.com/ru).

(c5) Webinars carrying out –the description of such platforms is made, for example,

at <https://vc.ru/services/51104-gde-provesti-vebinar-obzor-10-luchshih-ploshchadok>. However, for webinars, tutors are limited in their ability to receive the students' feedback.

(c6) Implementation of traditional e-mail facilities including different mailboxes for different student groups.

(c7) With some reservations the use of social networks, sending SMS notifications via smartphones, etc. It is necessary to note that when anti-epidemic measures were introduced (as it is in Russia in 2020) DLT implementation can be considered as an uncontested option of educational process organization in RRSU, even for full-time students.

The enumerated components are generally typical for the DLT implementation in Russia and abroad [7,9,11], they provide opportunities for the realization of distance learning basic principles [12, 14], their education methodical possibilities diversification [13]. However, the RRSU expenses for DLT should be planned and implemented taking into account the summary of "economic factors" and risks that need to be carefully analyzed and adequately forecasted.

3 The Structure Analysis of RRSU Expenses for the Distance Learning Technologies Implementation

Expenses main directions.

(d1) Server equipment is the key technical element in DLT realization in Universities. Expenses structure: equipment procurement, putting into operation, operating condition maintaining, permanent power supply ensuring. In typical cases RRSU once – and - for-all expenses for server equipment procurement and its operation ensuring means range from several million to tens of millions of rubles. Additionally, the expenses for server room equipment, air conditioning, fire alarm emergency fire fighting equipment, etc. are required. General system server software can be expensive.

(d2) Operating expenses: electricity payment – air conditioning devices and server operation; the cost of maintenance work at server equipment; server lost components replacement; if it is necessary server capacity expanding, RAID-arrays expanding; server mirroring performance.

(d3) Creation and operation of communication channels based on modern telecommunication technologies. These items are especially actual for DLT, as many users in online modes can simultaneously work at their servers.

(d4) Providing Universities with audio conferencing systems for groups of students with tutors. However, during the implementation of anti-epidemic measures in RRSU face-to-face classes can be terminated and restrictions on employees visiting university buildings may be imposed. In such cases, distance classes with students are most often organized by tutors from home including the use of video conferencing systems.

(d5) procurements and implementation of information security mean connected with DLT implementation; necessary organization measures implementation. It should be noted that RRSU are "personal data operators" for students and they carry out the legal responsibility for such data "leakage".

(*d6*) Search (selection) of the Russian language materials at external (according to RRSU) Internet sources for DLT use; such as materials adaptation.

(*d7*) Search (selection) of similar materials in foreign languages for the following purposes: foreign students training support at RRSU, as part of their self-study after classes, providing improved learning of the foreign languages by Russian students.

(*d8*) Conclusion of the contracts for paid access with different “electronic libraries” in the country and with publishing houses.

During the terms of their validity, such agreements provide for RRSU tutors and students some possibilities of remote access to educational resources. RRSU expenses under such agreements however allow significant savings in paper textbooks purchase, their storage, and librarian salary. At the same time, paper textbooks' obsolescence is quite fast. The use of “electronic libraries” educational resources is quite typical for DLT use abroad [10].

(*d9*) Independent elaboration of materials for DLT by RRSU staff, including “electronic textbooks”, presentations, control-test tasks, etc.

These elaborations are carried out by RRSU tutors for their salary during their “second part of their working day”. However, the execution of the most important work can be additionally paid for by RRSU. For “e-learning materials” the operational costs for keeping them up to date are also required. The reasons are the following: changes in regulatory documents, the emergence of new social-economic realities, software tools; changing of equipment characteristics, electronic components, etc.

(*d10*) Professional translation of educational and other materials for DLT into foreign languages. Such materials can be used in general at university preparatory divisions (self-training for students who are in Russia) or for the preliminary (corrective) training of foreign citizens who intend to study at RRSU.

(*d11*) Specialized software tools elaboration for DLT realization, including as “add-ons” to LMS Moodle. In the large RRSU their own ST elaborations, providing DLT special functionality can be implemented.

(*d12*) Expenses on training and/or advanced training of developers (creators) of education materials for DLT, including classes paid by RRSU.

(*d13*) Payment for service staff, maintaining servers and telecommunication facilities, distance learning systems.

4 Social-Economic Effects From DLT Implementation

For RRSU «beneficial effects» (BE) include the following.

(*e1*) Increasing the students' quantity in RRSU also by persons with disabilities [5]; by persons who need advanced specialty options. At the same time, the DLT use allows RRSU to fulfill the admission plan for “budget places” for mixed-mode and part-time studies often to provide good recruitment for commercial places. Quantitatively the economic effect for RRSU under this item can be evaluated mainly only expertly.

(*e2*) Left-out decreasing during their study in RRSU including their transitions to other universities. The reason is the DLT use allows if necessary to help students to

learn the material themselves (or with the tutor's help); in some cases, it provides individualization of educational trajectory.

(e3) Expansion of the second graduate degree receiving by full-time students in RRSU on a commercial basis.

(e4) Students learning outcomes improving by increasing the quality of «electronic educational materials», available remotely also for full-time students [1]. At the same time improving the students' motivation for studying can decrease the number of academic debts, retaking of exams, etc. in such a case workload for tutors and dean's office employees decreases. Besides, improving the quality of students' learning makes it easier for universities to enroll for the post-graduate course, the formation of their teaching staff for the account of their graduates.

(e5) RRSU classroom fund workload reducing; for PC in-display classes from the students' side.

(e6) Reducing RRSU buildings depreciation, their elevator facilities, air conditioning systems by reducing the students' flow.

(e7) Expenses reduce for RRSU staff: librarians, wardrobe workers, cleaners, etc.

(e8) Reducing students' direct contact with tutors, university staff, and other students. Consequences: reducing of the possibility of infectious diseases spreading, the total duration of university employees inactivity periods; students combining study with working.

(e9) Expansion of the RRSU «teaching staff» by recruiting persons who find it difficult to visit the university buildings or who can work remotely.

(e10) The competent use of DLT at RRSU allows for reducing the tutor's real workload.

(e11) In general, the use of DLT makes it possible to reduce the cost of educational process organizing for mixed-mode and part-time students. As a result, RRSU assigns significantly lower "semester" costs for commercial study in comparison with full-time study.

(e12) Education with DLT implementation for students of mixed-mode and part-time mode also potentially contributes to establishing relations of RRSU and those organizations in which students work; providing full-time students with places of practical training and in some cases with the future workplace and sometimes the conclusion of economic agreements with such organizations. In some cases, the graduates from RRSU work abroad, it can develop international relations of Russian universities including the future recruiting of foreign students [3].

Now it is necessary to give BE from DLT use for regions of RRSU and employers location.

(e13) Education quality improvement (EQI) by the DLT use also provides an increase in gross regional products (GRP) of the regions and earlier student's acquisition of professional knowledge: work skills in professional teams, etc. If students work during their study at RRSU, so BE from EQI can take place immediately for the employing organizations, and in the case of students recruitment for work after graduation from RRSU, they may be delayed in nature. In practice, the main "benefit" from the EQI of the students is taken by the regions where these RRSU are located. The reason is the

following: especially in these regions the most of the students live permanently, and the «labor mobility» of the Russian population is relatively low.

(e14) the increasing of the DLT use in RRSU also allows more full-time students to combine study with work including class attendance “individual schedule”. Also, it allows such students to join the labor process earlier, which provides the increase in GRP of the regions during the studying process.

(e15) It is necessary to note the specific BE from EQI in universities. For medical students, this is an improvement in the health status of the regional population. The consequences are the following: lengthening of the working life period; reduction of regional expenses on healthcare, etc. for pedagogical universities students it is an improving the quality of training of school graduates and as a result, reducing the labor costs of universities to eliminate the shortcomings of school education in students teaching.

Schematically the interconnections of some BE the income of funds in RRSU of the quality and the number of educational materials for DLT are presented in Fig. 2.

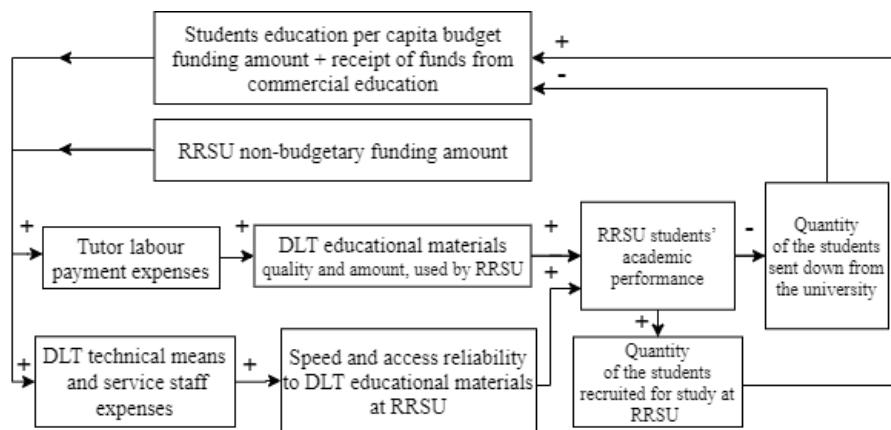


Fig. 2. Cognitive diagram of the relationship between BE, revenue, and expenditures of RRSU («+» - positive influence, «-» - negative influence).

5 Factors to Consider while Evaluating DLT Cost-Effectiveness

When evaluating the RRSU cost-effectiveness for DLT implementation and use it is necessary to consider the following.

(f1) Only BE part from DLT use can be more or less accurately quantified.

(f2) In many cases, the beneficiary from the DLT use is not RRSU themselves but the region of its location and /or the employing organizations of university graduates mainly operating in the same regions.

(f3) The cost of DLT use and BE from these costs are strongly stretched in time. At the same time using quantitative estimates of the profitability of discount factors to bring costs and revenues to the general price scale for future periods is difficult. The

main reason is the significant uncertainty in the estimates of inflation processes in the country in future periods.

(f4) There are a significant number of factors of uncertainty and risk that can significantly affect the number of full-time, part-time, and mixed study at RRSU and the left-out rate of the students in the learning process. At the same time, the need for educational materials for DLT and the actual amount of their use is mainly affected the number of mixed-mode and part-time study students. However, during the periods of difficult epidemiological situations and cancellation of full-time studies at universities materials for DLT are in great demand in full-time student education.

These factors can significantly affect the assessment of the appropriate amount of elaboration of training materials and the use of DLT at RRSU; profitability of their costs in areas related to DLT, etc.

Significantly, the initial elaboration or adjustment of different materials for DLT is often carrying out by the RRSU tutors in parallel with each other. At the same time, their resources which can be used to carry out the elaboration are usually quite limited and need to be directly allocated in time. This also applies to the resources of the RRSU unit employees which provide informational and methodological support for the elaboration, linking the DLT materials to the tutors, studying groups, and sometimes to individual student debtors.

Therefore for planning and monitoring the implementation of work related to the DLT use in RRSU it is necessary to use the project management methodology. The most famous ST providing support for such methodology in Russia is Microsoft Project. However, there are native developments including providing remote project management, for example, Advanta (<https://promo.advanta-group.ru/promo>).

It is necessary to note that in addition to supporting elaboration planning for DLT software tools allow you to provide convenient planning opportunities for individual learning paths of students and tracking compliance with planned deadlines.

6 Mathematical Models for Evaluating the Cost-Effectiveness of the Elaboration and Use of Materials for DLT

Firstly let's observe the model for evaluating the profitability (Ψ) of costs from the RRSU perspective for the period of « T » years. For simplicity, we will not take into account the coefficients of the discounting costs and revenues. Then it is possible to accept

$$\Psi = 100\% \times \sum_{t=1}^T \left(\left(A_t^{(1)} + A_t^{(2)} \right) - \left(A_t^{(3)} + A_t^{(4)} \right) \right) / \left(A_t^{(3)} + A_t^{(4)} \right) \quad (1)$$

where the estimates for the t -year are equal to the following: $A_t^{(1)}$ - BE sum; $A_t^{(2)}$ - the amount of damage prevented (DP); $A_t^{(3)}$ - RRSU expenses sum; $A_t^{(4)}$ - the sum of monetary disk assessments connected with DLT use. The formulas for the individual components in (1) is as

$$A_t^{(1)} = \sum_{i=1}^I (V_{i,t}^{(1)} P_{i,t}) \quad (2)$$

where: I – the amount of potential combination of BE form the use of DLT and BE version; $P_{i,t}$ – in the t -year the BE value for the i -th combination BE from the DLT use

it is «BE variant»; $V_{i,t}^{(1)}$ – the probability in the t -th year for the i -th combination BE from the DLT use it is «BE variant». Such an approach allows if necessary to use the distribution of different BE variants for BE one type.

$$A_t^{(2)} = \sum_{j=1}^J V_{j,t}^{(2)} U_{j,t} \quad (3)$$

where: J – the number of potential combinations of DP from the DLT use and DP version; $U_{j,t}$ – in the t -th year the DP amount for the j -th DP combination of DP from the DLT use it is DP version; $V_{j,t}^{(2)}$ – a possibility in the t -th year for the j -th combination of DP from the DLT use it is DP version. This approach allows if necessary to use the probability of distribution for different DP variants for one DP type.

$$A_t^{(3)} = \sum_{k=1}^K V_{k,t}^{(3)} Z_{k,t} \quad (4)$$

where: K – the number of potential combinations of the value of expenses according to the DLT type and «expenses version for this type»; $Z_{k,t}$ – in the t -th year the number of expenses for the k -th combination of «expenses type for DLT » is an «expenses version»; $V_{k,t}^{(3)}$ – the probability in the t -th year for the k -th combination of «expenses type» it is «expenses type version». If necessary probability distribution can be used for various expense quantities for the same expenses type.

$$A_t^{(4)} = \sum_{m=1}^M V_{m,t}^{(4)} R_{m,t} \quad (5)$$

where: M – the number of potential combinations of risk type and risk type variant; $R_{m,t}$ – in the t -th year the risk value for the m -th combination of «type of risk from the DLT use» it is «variant of the type of risk»; $V_{m,t}^{(4)}$ – probability in the t -th year for the m -th combination of «type of risk from the DLT use » it is «variant of the type of risk». If necessary the probability distribution for different variants of risk values for the same type of risk can be used. Formulas (1)...(5) provide the basis for choosing optimal solutions to form RRSU interests.

In principle, the same model can be written for RRSU tutors to evaluate the cost-effectiveness of their work. However, it will have the following peculiarities.

(1) Income may include the basic part of the salary (it can be connected with DLT); additional payment from the RRSU side for DLT elaboration; hourly wages associated with tutors using DLT.

(2) Damage prevented – they are connected in general with the decrease of the possibility of education process interruption when anti-epidemic measures are introduced in the regions and as a result cancellation of full-time classes.

(3) Expenses. Additional financial costs are usually absent or small. Labor costs can be converted into monetary form based on an estimate of the cost of man-hours of work.

(4) Risks –monetary assessments can be given not only concerning the use of technology and ST but also to ensure interaction with students including their claims elimination.

When assessing the profitability of the DLT use for the regions of RRSU location it is necessary to take into account not only BE associated with increasing of the population educational level but also damage prevented associated with the decrease in the number of contacts of tutors and students (with each other and with other individuals) in a difficult epidemiologic situation in the regions.

7 Conclusion

The DLT development allows increasing significantly the student number in RRSU, to diversify the forms and methods of the educational process based on the use of modern information and telecommunication technologies with reservations to reduce the students' left-out in the education process. However, the expansion of DLT use in RRSU requires significant expenses in various areas which should be of a balanced nature. For planning the implementation (expansion of the use) of DLT, including their budgeting, it may be appropriate to use the project management methodology. In general estimations of the cost-effectiveness of DLT from the perspective of the interests of RRSU are hampered by high levels of uncertainty for the forecast information based on which appropriate decisions should be made.

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