Research on E-Learning Development Trends as Russian Federation Economy Digitalization Direction[*]

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Abstract. Digitalization is changing business form in a digital reality based on data. The first of all it means new business processes, organizational structures, regulations, a new responsibility for data, new role models. This article represents research results on e-learning development trends as the Russian Federation economy digitalization direction. It is given educational startups market analysis and its features. With startups help one can develop motivational systems that have large opportunities within material presentation framework and interaction with students. Statistical data on distance learning development in the Russian Federation is described. Due to the large distances between educational centers in the Russian Federation online distance learning is becoming increasingly popular. The growth of broadband Internet access penetration here also is a positive factor for digital education development. Education as part of the economy must be not only a kind of investment to future generations' knowledge but also a profitable area. Higher education institutions must be economically successful for its sustainable functioning and it must receive profit from its activities. Also e-education economic aspects mathematical model is suggested.

Keywords: E-learning, Digitalization, Startups.

1 Introduction

Nowadays the economy is characterized by digital transformation that is changing business form in a digital reality based on data. The first of all it means new business processes, organizational structures, regulations, a new responsibility for data, new role models. Education as part of the economic structure is also involved in this process. Digital transformation is not limited to the use of technologies such as Big Data, the Internet of things, augmented reality, blockchain and so on. In relation to digital transformation, all companies can be divided into two sectors: the virtual sector and real companies' one. Digital transformation will have its own characteristics for each of the sectors.

Education as part of the economy must be not only a kind of investment to future generations' knowledge but also a profitable area.

The article's aim is to make research on e-learning development trends as the Russian Federation economy digitalization direction. It can be subdivided into tasks:

1) to describe digitalization tendencies in modern educational processes;

2) to analyze statistical data on the e-learning development in the Russian Federation:

3) to suggest e-education economic aspects, mathematical model.

2   Materials and Methods

In the article, there were used general scientific and special research methods to solve the mentioned aim. There are economic modeling, graphical analysis, statistic, techno-economic, system and structural analyses, expert estimation method. It was studied theoretical and applied papers on the research topic [1-15], also official statistics data.

3   Main content. E-learning development trends as the Russian Federation economy digitalization direction

3.1   Digitalization tendencies description in modern educational processes

During the research, it was analyzed different digital transformation tendencies in modern educational processes. The most illustrative from them are different educational startups that can be represented in different models:

There are a few business models for educational startups:

1. "Free course – paid certificate" business model. The sale of a paid certificate that confirming the course passing is the most popular model primarily due to Coursera (the project attracted 146,1 million dollars in 6 rounds from 12 investors, including the World Bank and Yuri Milner who is the former Chairman Mail.ru Group Directors Board).

2. "Paid course" business model. On the EdX platform "Professional Education" section courses are paid. The EDX is registered as a non-profit organization and working on open-source software raised 30 million dollars from Harvard and MIT. They are aimed at participants' highly specialized skills development. Udemy paid courses beyond 500 Startups on Seed and Series A stages raised 113 million dollars in 5 rounds from 16 investors, and also Insight Venture Partners. The Geekmath application authored by Moscow State University associate professor offers courses in higher mathematics, statistics, linear algebra, econometrics, etc. The educational process is the course studying by reading an interactive textbook that is written for the humanities and includes problem solutions and a large number of comments. The course on econometrics consists of 10 topics that are divided into 32 lessons, and now it costs 119 rubles and is intended for the general public.

3. "Selling a program that is formed from a set of courses" business model. This model is used by Coursera that offers several courses that are formed into one vocation.

The same model is also used by edX that calls it the "Series of Courses". For some projects, it is cheaper to buy a package than paying for parts separately.

4. "Selling video" business model. The Russian Be smart project attracted 4 million dollars from the Education Matrix in December 2013. It is a trading platform that provides free opportunity to place one's own educational texts, graphics, audio and video files, then to set a price and receive payments after viewing the mentioned materials. The difference from YouTube channels is that on Besmart the videos are intended for a not wide audience, so they will not be able to be achieved by a large number of course visitors.

5. "Certain period subscription sale" business model. There are two types of subscriptions:

A. Buying access to content. The most famous project in Russia in this area is Neurology. It raised 2,7 million dollars in 2 rounds from Inventure Partners and Buran Venture Capital). The project team believes that when students pay for a period, they behave better and learn on average two courses per month. In the world project, Lynda.com has raised 289 million dollars in 2 rounds from 4 investors. The project specializes in computer programs use courses including graphic editors, and it is very profitable.

B. Educational resources additional opportunities use. This model is called Freemium. The LinguaLeo project raised 3 million dollars in 3 rounds from 3 investors. The project of the Free Innovation Research Institute Easy Ten is available with subscription (on February 2018 annual subscription costs 699 rubles in the AppStore). Auto-renewable subscription costs 2,99 dollars per month.

6. "Advertising" business model. This is a classic business model for online projects and mobile application earnings.

7. "Programs with webinars" business model. Programs with webinars launched by mentioned above Netology that specializes in online professions. A large number of projects operate in this segment, and the most often such programs are difficult to fit into the startup concept but they are educational business good examples. In this case, the risk of large number programs is a need to recruit participants for each educational flow.

8. "Programs with personal studies" business model. An excellent example of such a business model is Skyeng (the project received a grant of 13 thousand dollars in 2012, also Alexander Laryanovsky who is the former international development director at Yandex was among investors). Unlike other educational projects Skyeng aims to study only English with different levels and tasks.

9. "Educational environment additional and exclusive services providing" business model. This one is the platform for educational and scientific Internet conferences with a large number of participants for universities, and also a discussion platform. In the Mendeley project, one can create databases for storage that are used in social networks for scientists. The platform attracted 2 million dollars from 4 investors. Academia.edu project raised 17,8 million dollars in 4 rounds from 8 investors. The project suggests analyzing the content uploaded by the user and find similar research topics.

The list is not exhaustive but these business models can certainly be called the most indicative in the market.

Also, there is a need to describe educational startups features:

A. The educational startup is a project developed by teachers together with programmers.

B. It is a product that allows children and adults to learn with the help of modern technology.

C. If one speaks about the major educational startups they are always commercial projects aimed to make a profit.

There is an illustration of an average bill for e-education on mentioned models (fig. 1)
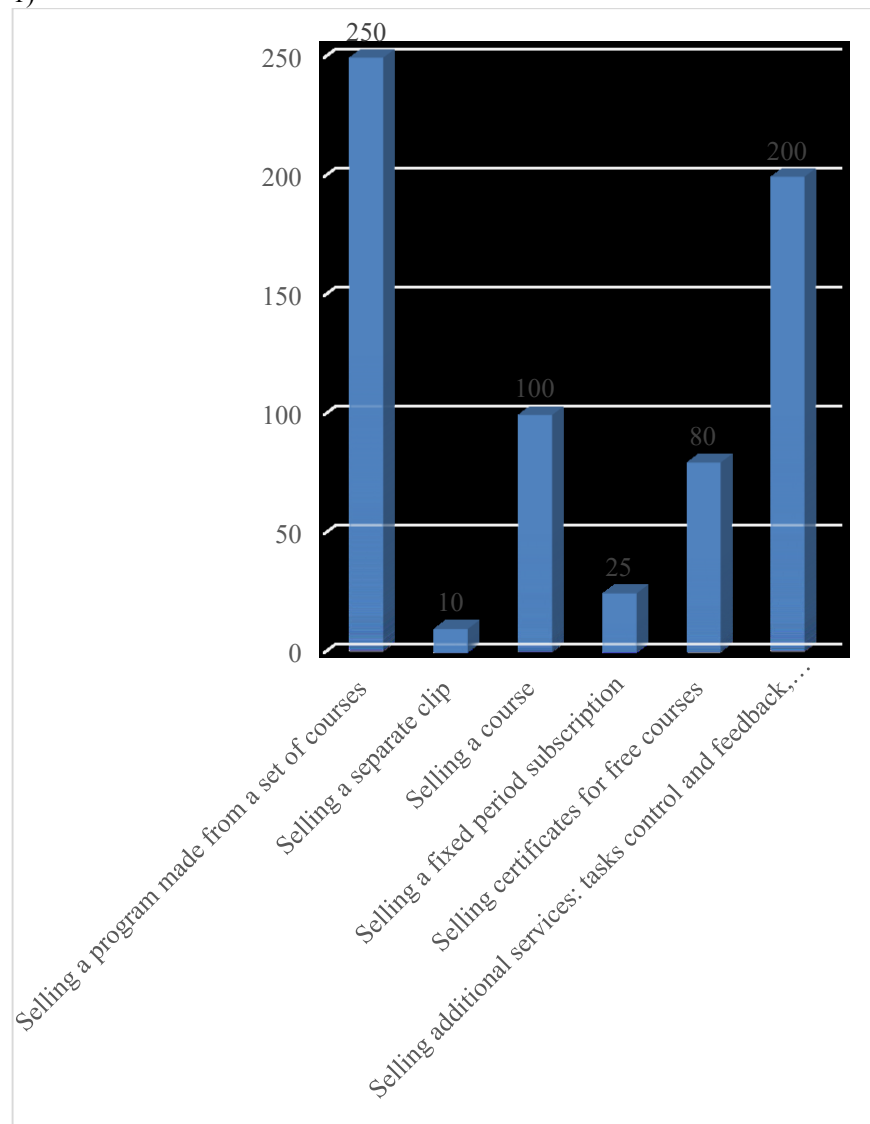

Fig. 1. An average bill for e-education on the mentioned models.

Fig. 1 The field of Education Technology (EdTech) is one of the fastest-growing areas. In this area, global investments are about 1 billion dollars. This market is still not fully developed. If there are hundreds of platforms and applications for learning English, then there are free niches that await young inventors.

Novelty is the main advantage of educational startups. They offer to acquire knowledge easily and are built in a way to make the process of education as interesting as possible. This allows keeping the audience attention. Many programs select tasks individually for the client based on one's preferences.

A startup is an answer to a problem in society. It is impossible to create a startup only on the desire to earn. This is usually associated with:

need for distance learning;

lack of money for education.

An educational startup combines modern technology and traditional learning. The opportunity to study at home through the Internet is a solution that saves the time of those who are constantly busy and also need knowledge.

Usually, startups cost either much cheaper than traditional education or even it is for free.

Coursera as the project was created in 2012, but still remains confident participants of the educational technology market. It was founded by computer science professors from Stanford University Andrew Ng and Daphne Koller. The resource is a typical representative of the MOOC sphere that provides mass open online courses on various topics. The service collaborates with universities, publishes educational materials and invites users to take tests and examinations directly on the Coursera website.

Open Education is a platform that offers free online courses on basic subjects taught at universities in Russia. The founders of the platform are the leading universities of the country (Moscow State University, Saint-Petersburg State University, and others). All courses are created to meet the requirements of state educational standards. After course completing the user receives a certificate.

Codecademy is an online platform for programming language learning as such as Python, PHP, JavaScript, Ruby, Java, HTML, and CSS. In total, this service is available in 12 languages. Each user has own profile and gets reward points for tasks correct execution.

Neurology is a Russian project where users get the opportunity to learn Internet marketing, business management, design, and programming. It is taught by experts from Google, mail.ru and Alfa Bank.

Foxford Portal is an online school where students are prepared for examinations and Olympiads. The service offers school tutoring from the third to the eleventh grade.

GeekBrains is an online university for studying programming with leading IT specialists. A nice bonus is free materials providing.

HTML Academy is a site that offers interactive online courses on HTML, CSS, and JavaScript.

Stepik is a platform for free online courses as well as lessons on a wide variety of topics, prepared by leading universities in Russia.

3.2   Statistical data analysis on the e-learning development in the Russian Federation:

Worldwide educational projects total investment amounted to 7,5 billion dollars in 2017-2018. 50% of the entire online education market belongs to the United States.

However, the growth of Asian one is evaluated in hundreds of percent.

The most popular is foreign language online learning including direct communication with native speakers. Online tutors, offline test preparation and corporate training are also very popular. In the corporate training segment lifelong learning is gaining popularity. That is the continuous process of personnel training in accordance with the external environment changing, new tasks, etc. During research it was disclosed that abroad remote technologies are used by many educational institutions:

— Open University (UK);
— National University of Technology (USA);
— University of Pennsylvania (USA);
— University of Western Governors (USA);
— Canadian Open University;
— University of South Africa;
— National University of Distance Education (Spain);
— The Open University of Israel;
— Open University of the Netherlands;
— Dutch Open University;
— French National Center for Distance Education, etc

Due to the large distances between educational centers in the Russian Federation online distance learning is becoming increasingly popular. The courses share is given in fig. 2.
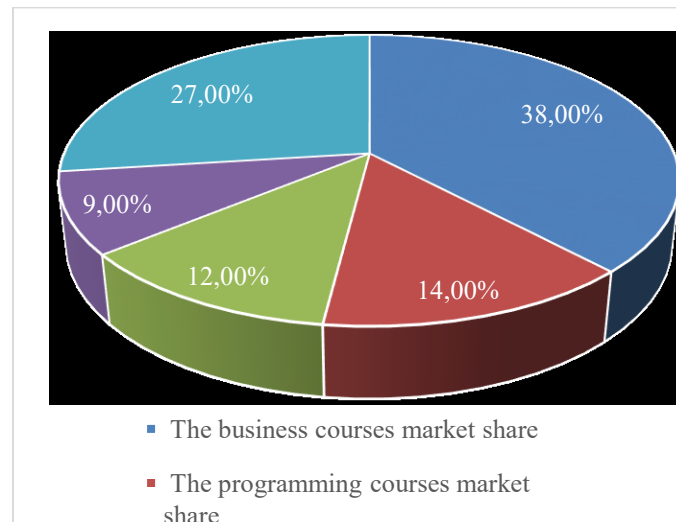

Fig. 2. The different courses market share in the online education total cost structure in the Russian Federation

The growth of broadband Internet access penetration here also is a positive factor for digital education development. Nowadays the Internet is applied by 73,41 % of the total population. These factors influenced a number of Russian universities (Moscow State University, Saint-Petersburg State University, Moscow Institute of Physics and Technology and others) which united created an electronic online learning platform "Open Education" that was supposed to compete with large international projects.

About 100 universities implement distance learning. Some have from 20 to 100 or even more branches. There is a network of correspondence schools, remote training courses for students, the portal "Open Education". Distance learning is used at all levels of the educational system and in corporate training. In post-Soviet Russia Uralsib, VimpelCom, Ministry of Railway Transport (since 2003), Sibneft, Severstal, Norilsk Nickel, Sberbank, AvtoVAZ (since 2005) have become the pioneers of distance learning.

The target audience of distance learning programs is considered to be people aged 30 years and older, as well as people belonging to certain social groups – applicants, disabled people, young mothers, military personnel, and also ones who are living in remote areas. Distance vocational training is used to train lawyers, railway workers, clergymen, and many other professions.

Secondary school e-learning is received by disabled children, villagers, children of Russian compatriots from the CIS and Baltic countries. When companies use distance learning they receive direct economic benefits that are reducing the travel and accommodation cost, almost not distracting employees from work processes. According to SloanConsortium the most often distance learning was used by commercial educational and training companies, financial organizations, IT companies.

The object of the study also highlighted two main segments in e-education:

— scheduled courses that are possible to be accessed at the set time (directly online training);
— courses without a schedule (recorded lectures).
— The main product of educational platforms is content. Today there are several ways to produce it:
— display of finished content (aggregators);
— content adaptation (translation, consolidation);
— use of custom content (service functions for translation);
— content own production.
— The main trends in the development of the global online education market are:
— the growth of micro-courses popularity with one video duration for 1-3 minutes;
— gamification that is tutorials presentation in the game form that allows keeping user's attention better;
— augmented and virtual reality technology applying;
— B2B market active development;
— applied skills training growing popularity (the point of high interest in the Russian Federation).

According to the expert's opinion, the most perspective is a hybrid model that includes online and offline education tools.

B2C segment includes:

— the MOOC courses segment, open online participatory courses designed for an un-limited number of students;
— videos, including YouTube, social networks, etc.;
— skype training;
— mobile applications.
— B2B segment includes:
— corporate MOOC courses that are designed for employees training or development;
— individual education solutions.

The research shows that more than the third of online education costs fell on business courses in 2018. Also, it was analyzed data on more than 427 thousand bills worth over 1,4 billion rubles generated by Russian online training platforms with using the ATOL Online ticketing service. By author's own estimation it is more than 70 % of the e-commerce market (it was taken into account the purchases made in Russian online stores and paid by electronic payments).

The total volume of the online education market taking into account independent market participants is 21 billion rubles. These data reflect 31 online schools in Russia. Four of them are on online platforms of the largest Russian universities and 27 are independent educational online platforms. 1389127733 rubles is the total cost of online courses paid by Russians on the Internet in 2018.

3.3 E-education economic aspects mathematical model

E-education must be economically successful for its sustainable functioning and it must receive profit from its activities. As the mathematical model of such activity the authors take equations:

$$\begin{cases} \frac{dz}{dt} = \alpha(U - z)z - \gamma z \\ \frac{dN}{dt} = KUo\left(1 - \frac{N}{No}\right) - BN \\ \frac{dp}{dt} = \gamma\left[\frac{A}{P} - Bp\right] \end{cases} \qquad (1)$$

The upper equation of the system (1) is a simulation model for a student's knowledge level z dynamics, α and γ are coefficients of student's remembering and forgetting of information that one is received during the educational process. U is the requirements level for the student. The solution of this equation is:

$$\int_{Z(o)}^{Z(t)} \frac{dx}{x^2 - (U - \frac{\gamma}{a})x} = -at = \int_{Z(o)}^{Z(t)} dx \frac{1}{U - \frac{\gamma}{a}}\left[\frac{1}{x - (U - \frac{\gamma}{a})} - \frac{1}{x}\right] = \frac{1}{U - \frac{\gamma}{a}} \ln \frac{z(o)\left[z(t) - (U - \frac{\gamma}{a})\right]}{z(t)\left[z(o) - (U - \frac{\gamma}{a})\right]} \qquad (2)$$

Thence:

$$\frac{z(o)\left[z(t) - (U - \frac{\gamma}{a})\right]}{z(t)[z(o) - (U - \frac{\gamma}{a})]} = e^{-a\left(U - \frac{\gamma}{a}\right)t} \qquad (3)$$

The solution of equation (3) is:

$$Z(t) = \frac{z(o)(U - \frac{\gamma}{a})}{z(o)\left(1 - e^{-a\left(U - \frac{\gamma}{a}\right)t}\right) + (U - \frac{\gamma}{a})e^{-a\left(U - \frac{\gamma}{a}\right)t}} \tag{4}$$

If $U > \frac{\gamma}{a}$, that $\lim\limits_{t \to \infty} Z(t) = (U - \frac{\gamma}{a})$ (5)

The lower equation of the system (1) describes the dynamics of the education cost P depending on the demand $\frac{A}{P}$ and supply BP. A and B are the coefficients of supply and demand. Multiplying the right and the left sides of this equation by P, the authors get:

$$P\frac{dp}{dt} = \frac{d}{dt}\frac{p^2}{2} = \gamma[A - BP^2] \tag{6}$$

In the result of integrating equation (5) it will be received:

$$\int_{P(o)}^{P(t)} \frac{Bdp^2}{Bp^2 - A} = 2\gamma Bt = \ln\frac{Bp^2(t) - A}{Bp^2(o) - A} \tag{7}$$

On solving equation (6) it will result:

$$P(t) = \sqrt{\frac{A}{B} + \left(p^2(o) - \frac{A}{B}\right)e^{-2\gamma Bt}} \tag{8}$$

that makes:

$$\lim\limits_{t \to \infty} P(t) = \sqrt{\frac{A}{B}} \tag{9}$$

The middle equation of the system (1) describes the dynamics of the students' numbers that are studying at a given university. It needs to transform this equation into the form:

$$\frac{dN}{dt} = KU_o - \left(\frac{KU_o}{N_o} + B\right)N = -\left(\frac{KU_o}{N_o} + B\right)\left(N - \frac{KU_o}{\frac{KU_o}{N_o} + B}\right) \tag{10}$$

Here $U_o = const$ is the intensity of advertising at the given e-education structure, N_O is the maximum number of students who have the opportunity to study at the given university, B is the probability of student deduction and leaving from the e-learning. The solution of the equation (9) is:

$$N(t) = \frac{KU_o}{\frac{KU_o}{N_o} + B} + \left(N(O) - \frac{KU_o}{\frac{KU_o}{N_o} + B}\right)\exp\left\{-\left(\frac{KU_o}{N_o} + B\right)t\right\} \tag{11}$$

That makes:

$$\lim\limits_{t \to \infty} N(t) = \frac{KU_o}{\frac{KU_o}{N_o} + B}. \tag{12}$$

University income for the period TΔ is:

$$\Delta = \int_J^{J+T}(pN - p_oZ) = \left\{ \sqrt{\frac{A}{B}} \times \frac{KU_o}{\frac{KU_o}{N_o}+B} + p_o\left(\frac{\gamma}{a} - U\right) \right\}T \tag{13}$$

in which p_o is the expenditure of e-education structure funds per unit of knowledge, $J \gg 1$.

4 Conclusions

E-learning develops very fast in Russian Federation. And it is a rather profitable and popular area. Educational startups are playing an increasingly important role. This is due to distance learning technologies implementation in the educational process. But at the same time, there are certain difficulties associated with teachers' motivation, curricula and program preparation and approval at educational institutions, distance learning licensing courses development. To assess the potential of the online education market in Russia, it needed to estimate the volume of related markets: the tutoring segment and the corporate education market. According to available data, the aggregate market of tutors in the Russian Federation is estimated at 26-30 billion rubles, while the volume of the corporate education segment exceeded 70 billion rubles. The cumulative estimate of both segments is ~ 100 billion rubles. By 2019 the share of online education in these segments can reach 5-7%, which will be at least 6-8 billion rubles, of which most will be in the corporate segment. The suggested mathematical model is very important for the evaluation of e-learning effectiveness.

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