

# THE USING OF MOBILE APPLICATIONS IN E-LEARNING

**Andrey Tsaregorodtsev, Alexander Karasik**

Russian State Vocational-Pedagogical University, Informatics Faculty  
11 Mashinostroiteley St., Yekaterinburg, Russia  
andreytrety@hotmail.com

**Abstract:** *The article is devoted to the problems of using mobile applications in e-learning. The basic requirements for modern mobile applications that is designing for education. Describes the features of the mobile application "Chemistry".*

**Keywords:** e-learning, educational process, mobile device, mobile application

## INTRODUCTION

Modern information and communication technologies take part in educational process everywhere. So-called e-learning captures the minds of all participants of learning process. Nowadays all the tests, term papers and dissertations are done by computers, but before they were written by hand. Automated test systems are being used for testing knowledge. Electronic digital devices are being used for modeling different scenarios and all sorts of measurements. Different information and communications services and systems are being used for interaction between the participants of educational process

To date, one of the fastest growing areas in the industry of information technologies is the mobile industry (<http://canalys.com/newsroom/smart-mobile-device-shipments-exceed-300-million-q1-2013>; <http://www.gartner.com/newsroom/id/2525515>). According to a retrospective analysis of the global market for mobile applications, the average annual growth of the market is 293%. After 2012, the global market for mobile applications has reached 8 billion dollars in cash ([http://www.json.ru/files/reports/2013-08-07\\_Mobile\\_Development\\_MW\\_RU.pdf](http://www.json.ru/files/reports/2013-08-07_Mobile_Development_MW_RU.pdf)). Today everyone can download and install and configure the tools for developing mobile applications to further their coding for the selected operating system, then deploy your project in the specialized markets.

Big industry has emerged in the world of developers, whose interests are mobile applications. They affect all spheres of human activity, from games and applications for online store, to big training and educational systems. Mobile applications are

very popular because they are functionally rich and have got great technical capacities. They possess a high degree of mobility in the modern world. It is appreciated very highly.

Mobile information technology is penetrating in education.

## **1. INCLUDING MOBILE DEVICES IN LEARNING**

Many educational institutions around the world are actively implementing and using mobile devices and applications in their lessons.

Example, in schools of the United States tablets are replacing PCs. According to Apple Insider referring to a note to investors, analyst Charlie Wolf of Needham & Company shipment of personal computers in educational institutions of the United States declined by 265 thousand pieces or 13.9% in percentage terms for the last year. At the same time, Apple sold nearly 1 million iPads in the segment of secondary education in June 2013 ([http://www.cnews.ru/top/2012/09/06/v\\_shkolah\\_ssha\\_ipad\\_vytesnyaet\\_pk\\_v\\_rossiyskih\\_pochti\\_ne\\_ispolzuetsya\\_502027](http://www.cnews.ru/top/2012/09/06/v_shkolah_ssha_ipad_vytesnyaet_pk_v_rossiyskih_pochti_ne_ispolzuetsya_502027)).

Another example is that the Education Minister of France Vincent Peillon initiated the "digital era" in schools and proposed to use tablets in learning. "Tablets have significant motivational impact on the generations that were born when modern technologies arise. It was found that attention is kept much longer when using the iPad. This raises the question of visualization. Using devices with touch sensors offers many advantages including allowing the child to active take a part in learning. The ability to manipulate information makes it easier to assimilate. As in video games, a rare learning logic from own mistakes appears. It is easier to make mistakes. Losing streak in video games teaches us to win. Thus, this reinforces the desire to move forward" said child psychologist of the clinical hospital center of Pantene, Michael Stora (<http://www.atlantico.fr/decryptage/peut-on-se-fier-cette-etude-qui-montre-que-tablettes-permettraient-aux-enfants-mieux-reussir-ecole-michael-stora-philippe-cottie-753805.html>).

Many Russian educational institutions try to keep up with the world trends and also introducing mobile gadgets in educational process. So the experiment on introduction of e-books in secondary education ended in Russia (<http://www.rb.ru/article/v-rossii-zavershilsya-eksperiment-po-vnedreniyu-elektronnyh-uchebnikov-v-sredney-shkole/7044167.html>). The experiment was very successful and the participants left a lot of positive feedback.

## **2. KEY REQUIREMENTS OF EDUCATIONAL MOBILE APPLICATION**

If you take a closer look at using mobile devices, it can see that schools and universities are using mostly tablets and e-books and use them only as a means of

content consumption. In other words, students learn only consume information, but do not create it. This can lead to further oppression of creative and artistic abilities. The current using of mobile devices in educational process is missing the element of testing knowledge. It is also required when getting new knowledge. It follows from the above that this approach is ineffective.

The way out of this situation is redefining emphasis when using mobile devices. Instead of mobile gadget like a container for educational content, center of attention must be educational mobile applications with rich functionality that will enhance the effectiveness of the educational process. However, not every mobile application can be used as educational. It must meet a number of key requirements:

1. *Consistency and continuity.* All information should be providing sequentially, as if it was presenting in the course of the discipline. The information providing in each new section should base on the information in the previous section.
2. *Structure and conciseness.* All information of the subject area that is used by the application must be present in a structured and concise form. The user of the application must be aware of where he is, and he should not be confused with present information.
3. *Visibility and informational value.* The data, which used the application, should be concise and informative. It must be easily understood and remembered.
4. *The control of knowledge.* The application must have the functions of control of knowledge, because it is an integral part of the educational process.

You can also select several additional requirements to educational mobile applications. You can pay no attention to them, but they maybe taken into account in the development of educational mobile apps:

5. *Interactivity.* The application must allow the user to make different decisions in the course of its use and interact with it. This allows you to keep a child's attention for long periods and make an element of creativity.
6. *Communications.* The application must allow sharing results. For example, the exchange of test results between children and their parents through e-mail.

### 3. EDUCATIONAL MOBILE APPLICATION “CHEMISTRY”

A good example of educational mobile application is the mobile application "Chemistry", developed by the Russian State Vocational-Pedagogical University. The application is dedicated to the study of the science of chemistry. This science is difficult enough when you study at school and University.

The application “Chemistry” is a mobile application. It does not use internet connection and it includes all information.

Information in the application is to encourage the user to explore and interact with it directly, rather than through special buttons. Important information is presented immediately, secondary and detail information goes to the background, but is available in one action.

The application is developed for the version of the mobile operating system Windows Phone 7.1 and above. The application is constantly being updated and improved. Developers are adding new functions and features.

The application “Chemistry” is divided into 5 major programming blocks: "Elements", "Substances", "Tables", "Reactions" and "Control".

The block "Elements" provides a convenient interactive form with all known chemical elements (Figures 1, 2). All items are presented as tiles. Each tile displays basic information about chemical element: number, designation, name, radiation if it is radioactive. If a user chooses any element he navigates to a page that contains all the known properties and detailed description with the image of the element. All elements in the block are divided into groups according to the classification of the chemical elements in the periodic system D.I. Mendeleev.



**Figure 1. Page “Elements”**

Source: <http://www.windowsphone.com/ru-ru/store/app/хумия/6fce68c2-f961-47c2-94bd-59b53adbaba7>

ВОДОРОД / HYDROGENIUM

## СВОЙСТВА

АТОМНЫЕ

тип  
**неметалл**

порядковый номер  
**1**

обозначение  
**H**

молярная масса  
**1,00794 а.е.м. (г/моль)**

радиус  
**53 пм**

ХИМИЧЕСКИЕ


ковалентный радиус  
**32 пм**

радиус иона  
**54 (-1e) пм**

электроотрицательность  
**2,20 (шкала Полинга)**

степени окисления

## ОПИСАНИЕ



Водород — это первый элемент периодической системы элементов. Водород самый распространённый элемент во Вселенной. На его долю приходится около 92 % всех атомов. Он является основной составной частью звезд и межзвездного газа. Массовая доля водорода в земной коре составляет 1 %. Он является десятым по распространённости элементом на Земле. Практически весь водород на планете находится в виде соединений. Лишь в очень незначительном количестве водород в виде простого вещества содержится в атмосфере - 0,00005 % от общего объёма газов. Водород входит в состав

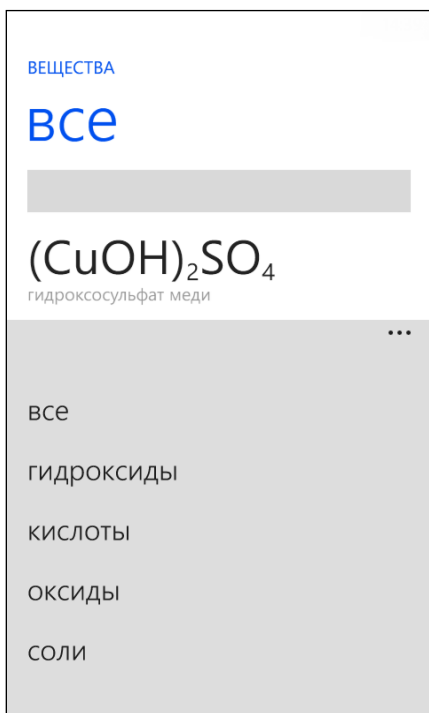
←
⊞
→
...
←
⊞
→
...

**Figure 2. Page of element “Hydrogen”**

*Source: Application “Chemistry”. Own elaboration*

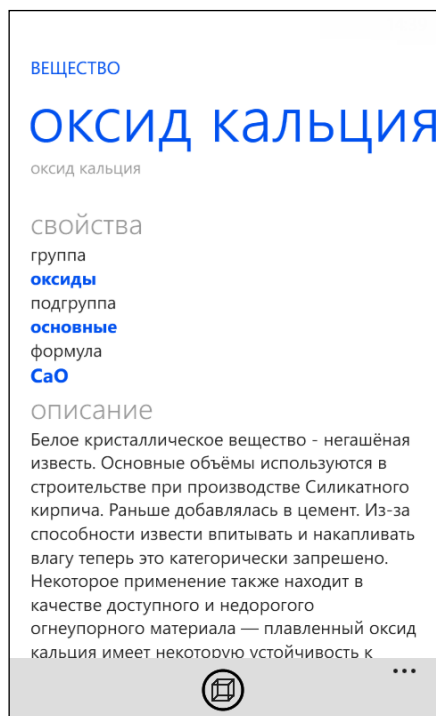
The block "Substances" contains many different substances studied as part of school disciplines (Figures 3, 4). All substances in this block are divided into groups according to the classification of inorganic chemistry. In addition, substances within groups are divided into subgroups. This block is implemented an interactive search to easily find the necessary substance within it. Each substance appears in two rows for ease of retrieval and perceptual information. The first (large) line contains the formula. The second line contains the name. When the user is choosing the substance, he navigates to the page with the detailed description about it. This page contains name, group, subgroup, formula and detailed description.

Blocks "Elements" and "Substances" also include a large number of 3d models of chemical elements and compounds (Figure 5). All 3d models are interactive. They can be rotated in different directions and scale using multitouch.



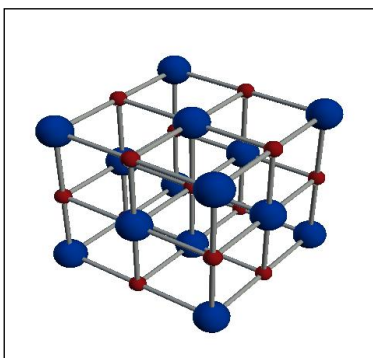
**Figure 3. Substance groups**

Source: Application "Chemistry".  
Own elaboration



**Figure 4. Page of substance  
"Calcium oxide"**

Source: Application "Chemistry".  
Own elaboration



**Figure 5. 3d-model of substance "Calcium oxide"**

Source: Application "Chemistry". Own elaboration

The block "Tables" includes the periodic system of chemical elements and table of solubility of salts and acids and bases (Figures 6, 7). All tables in this block are interactive. You can access information about element or substance.

МЕНДЕЛЕЕВА																		РАСТВОРИМОСТИ																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1 <b>H</b> водород																		2 <b>He</b> гелий																		
3 <b>Li</b> литий	4 <b>Be</b> бериллий												5 <b>B</b> бор	6 <b>C</b> углерод	7 <b>N</b> азот	8 <b>O</b> кислород	9 <b>F</b> фтор	10 <b>Ne</b> неон																		
11 <b>Na</b> натрий	12 <b>Mg</b> магний												13 <b>Al</b> алюминий	14 <b>Si</b> кремний	15 <b>P</b> фосфор	16 <b>S</b> сера	17 <b>Cl</b> хлор	18 <b>Ar</b> аргон																		
19 <b>K</b> калий	20 <b>Ca</b> кальций	21 <b>Sc</b> скандий	22 <b>Ti</b> титан	23 <b>V</b> ванадий	24 <b>Cr</b> хром	25 <b>Mn</b> марганец	26 <b>Fe</b> железо	27 <b>Co</b> кобальт	28 <b>Ni</b> никель	29 <b>Cu</b> медь	30 <b>Zn</b> цинк	31 <b>Ga</b> галлий	32 <b>Ge</b> германий	33 <b>As</b> мышьяк	34 <b>Se</b> селен	35 <b>Br</b> бром	36 <b>Kr</b> кrypton																			
37 <b>Rb</b> рубидий	38 <b>Sr</b> стронций	39 <b>Y</b> иттрий	40 <b>Zr</b> цирконий	41 <b>Nb</b> ниобий	42 <b>Mo</b> молибден	43 <b>Tc</b> технеций	44 <b>Ru</b> рутений	45 <b>Rh</b> родий	46 <b>Pd</b> палладий	47 <b>Ag</b> серебро	48 <b>Cd</b> кадмий	49 <b>In</b> индий	50 <b>Sn</b> олово	51 <b>Sb</b> сурьма	52 <b>Te</b> теллур	53 <b>I</b> йод	54 <b>Xe</b> ксенон																			
55 <b>Cs</b> цезий	56 <b>Ba</b> барий	57-71	72 <b>Hf</b> гафний	73 <b>Ta</b> тантал	74 <b>W</b> вольфрам	75 <b>Re</b> рений	76 <b>Os</b> осмий	77 <b>Ir</b> иридий	78 <b>Pt</b> платина	79 <b>Au</b> золото	80 <b>Hg</b> ртуть	81 <b>Tl</b> таллий	82 <b>Pb</b> свинец	83 <b>Bi</b> висмут	84 <b>Po</b> полоний	85 <b>At</b> астат	86 <b>Rn</b> радон																			
87 <b>Fr</b> франций	88 <b>Ra</b> радий	89-103	104 <b>Rf</b> рифмий	105 <b>Db</b> дубний	106 <b>Sg</b> сегбий	107 <b>Bh</b> борий	108 <b>Hs</b> хассий	109 <b>Mt</b> метенерий	110 <b>Ds</b> дармштатий	111 <b>Rg</b> роентгений	112 <b>Cn</b> коперник																									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
57 <b>La</b> лантан	58 <b>Ce</b> церий	59 <b>Pr</b> празитрий	60 <b>Nd</b> неодим	61 <b>Pm</b> прометий	62 <b>Sm</b> самарий	63 <b>Eu</b> европий	64 <b>Gd</b> гадолиний	65 <b>Tb</b> тербий	66 <b>Dy</b> диспрозий	67 <b>Ho</b> гольмий	68 <b>Er</b> эрбий	69 <b>Tm</b> тмий	70 <b>Yb</b> иттербий	71 <b>Lu</b> лютеций																						
89 <b>Ac</b> актиний	90 <b>Th</b> торий	91 <b>Pa</b> протактиний	92 <b>U</b> уран	93 <b>Np</b> нептуний	94 <b>Pu</b> плутоний	95 <b>Am</b> америций	96 <b>Cm</b> кюрий	97 <b>Bk</b> берклий	98 <b>Cf</b> калифорний	99 <b>Es</b> эйнштейний	100 <b>Fm</b> фермий	101 <b>Md</b> менделевий	102 <b>No</b> нобелий	103 <b>Lr</b> лоренций																						

Figure 6. Mendeleev's table

Source: Application "Chemistry". Own elaboration

МЕНДЕЛЕЕВА РАСТВОРИМОСТИ

	H <sup>+</sup>	NH <sub>4</sub> <sup>+</sup>	K <sup>+</sup>	Na <sup>+</sup>	Ag <sup>+</sup>	Ba <sup>2+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	Mn <sup>2+</sup>	Zn <sup>2+</sup>	Ni <sup>2+</sup>	Sn <sup>2+</sup>	Pb <sup>2+</sup>	Cu <sup>2+</sup>	Hg <sup>2+</sup>	Hg <sub>2</sub> <sup>2+</sup>	Fe <sup>2+</sup>	Fe <sup>3+</sup>	Al <sup>3+</sup>	Cr <sup>3+</sup>		
OH <sup>-</sup>		P	P	P	-	P	M	M	H	H	H	H	H	H	H	-	-	H	H	H	H	OH <sup>-</sup>
NO <sub>3</sub> <sup>-</sup>		P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	-	P	P	P	P	NO <sub>3</sub> <sup>-</sup>
F <sup>-</sup>		P	P	P	P	P	M	H	M	P	M	P	P	M	P	-	M	M	H	M	M	F <sup>-</sup>
Cl <sup>-</sup>		P	P	P	P	H	P	P	P	P	P	P	P	M	P	P	H	P	P	P	P	Cl <sup>-</sup>
Br <sup>-</sup>		P	P	P	P	H	P	P	P	P	P	P	P	M	P	M	H	P	P	P	P	Br <sup>-</sup>
I <sup>-</sup>		P	P	P	P	H	P	P	P	P	P	P	P	H	-	H	H	P	-	P	P	I <sup>-</sup>
S <sup>2-</sup>		P	P	P	P	H	-	-	-	H	H	H	H	H	H	H	H	H	H	-	-	S <sup>2-</sup>
SO <sub>3</sub> <sup>2-</sup>		P	P	P	P	M	M	M	M	H	M	H	-	H	-	-	-	M	-	-	-	SO <sub>3</sub> <sup>2-</sup>
SO <sub>4</sub> <sup>2-</sup>		P	P	P	P	M	H	M	P	P	P	P	P	H	P	P	M	P	P	P	P	SO <sub>4</sub> <sup>2-</sup>
CO <sub>3</sub> <sup>2-</sup>		P	P	P	P	H	H	H	H	H	H	-	-	H	-	-	H	H	-	-	-	CO <sub>3</sub> <sup>2-</sup>
SiO <sub>3</sub> <sup>2-</sup>		H	-	P	P	H	H	H	H	H	H	-	H	-	-	-	H	-	-	-	-	SiO <sub>3</sub> <sup>2-</sup>
PO <sub>4</sub> <sup>3-</sup>		P	P	P	P	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	PO <sub>4</sub> <sup>3-</sup>
CH <sub>3</sub> COO <sup>-</sup>		P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	M	P	P	P	P	CH <sub>3</sub> COO <sup>-</sup>
	H <sup>+</sup>	NH <sub>4</sub> <sup>+</sup>	K <sup>+</sup>	Na <sup>+</sup>	Ag <sup>+</sup>	Ba <sup>2+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	Mn <sup>2+</sup>	Zn <sup>2+</sup>	Ni <sup>2+</sup>	Sn <sup>2+</sup>	Pb <sup>2+</sup>	Cu <sup>2+</sup>	Hg <sup>2+</sup>	Hg <sub>2</sub> <sup>2+</sup>	Fe <sup>2+</sup>	Fe <sup>3+</sup>	Al <sup>3+</sup>	Cr <sup>3+</sup>		

Figure 7. Table of solubility

Source: Application "Chemistry". Own elaboration

The block "Reactions" allows for a variety of reactions between chemical elements and substances and presents the results of reactions in a convenient interactive form

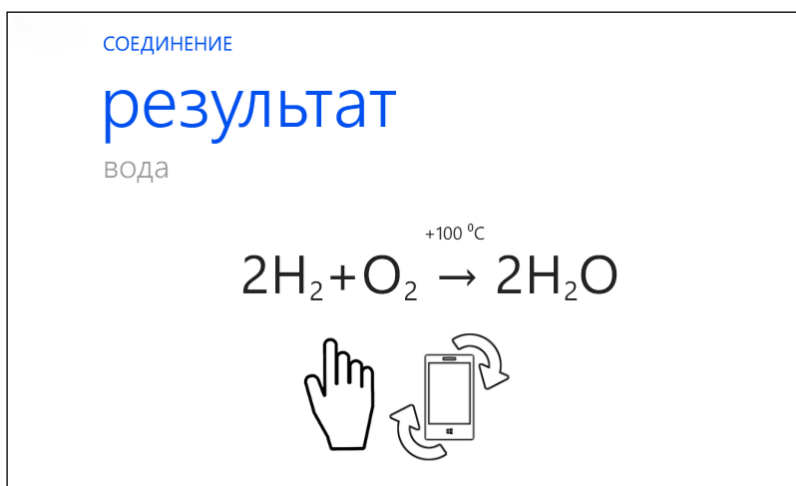
(Figures 8, 9). In any reaction user allows to select from one substance to two substances. After the reaction, by clicking on the appropriate button, the application switches to the page with the reaction result. This page contains reaction formula.

REACTIONS

соединение	разложение	обмен	замещение
первое вещество: азот	вещество: гидроксид железа (II)	первое вещество: азотная кислота	первое вещество: алюминий
второе вещество: кислород	разложить	второе вещество: оксид меди	второе вещество: соляная кислота
соединить		обменять	заместить

**Figure 8. Page “Reactions”**

*Source: Application “Chemistry”. Own elaboration*



**Figure 9. Page of reaction result**

*Source: Application “Chemistry”. Own elaboration*

These blocks are reference material. It can be used in the educational process for study the elements and their structures and for study the periodic table and for study substances inorganic chemistry and for study the table of solubility of substances and for study the basics of reaction formulas. All the information in them is very good to remember and learn.



The main tool in testing knowledge is the block "Control" (Figures 10, 11). It provides various kinds of tasks in a test form from the name of an element, to insert the missing substance in the reaction formula. Each type of test contains ten questions. It randomly generates when loading of a test. After passing, the test counts the time and the percentage of correct answers. You can study errors made during the test for more learning. Many of the items are in colors for better understanding and memorizing. The list of tests is constantly update.

**Figure 10. Page of test  
"Name of an element"**

*Source: Application "Chemistry".  
Own elaboration*

**Figure 11. Page of test result**

*Source: Application "Chemistry".  
Own elaboration*

Taking into account the foregoing, the application is fully consistent with the key requirements.

To date, the application "Chemistry" downloaded over 45 thousand users. Rating is 4.5 out of possible 5 points. Users left about 270 ratings and reviews from Belarus, Great Britain, Latvia, Russia, Ukraine and United States of America. Many users really help track errors that relate to the subject area when they left feedbacks, because a very large amount of information. All users agree that the educational mobile application "Chemistry" is awesome. They are even willing to pay for it.

In general, the application "Chemistry" is designed in such a way that it can be used as a reference platform for developing educational mobile applications for other substantive and scientific areas.

## CONCLUSION

To sum up, educational mobile applications have a great future. In connection with the spread of education and its orientation towards the use of new technologies and means of education educational mobile applications will be very good assistants when studying a variety of scientific areas. Technology that helps to develop mobile applications allows you to make the process of learning more interesting and interactive. It is the most important thing. Of course, this advantage will affect the quality of learning.

## REFERENCES

- Atlantico: *Can we rely on study, which shows that tablets would enable children to better succeed in school?* [In French] available at <http://www.atlantico.fr/decryptage/peut-on-se-fier-cette-etude-qui-montre-que-tablettes-permettraient-aux-enfants-mieux-reussir-ecole-michael-stora-philippe-cottie-753805.html>, (accessed on 13 September 2013)
- Canalys: *Smart mobile device shipments exceed 300 million in Q1 2013*, available at <http://canalys.com/newsroom/smart-mobile-device-shipments-exceed-300-million-q1-2013>, (accessed on 13 September 2013)
- CNews: *iPad is more popular than PC in the USA while it is almost not used in Russia*, available at [http://www.cnews.ru/top/2012/09/06/v\\_shkolah\\_ssha\\_ipad\\_vytesnyaet\\_pk\\_v\\_rossiyskih\\_pochti\\_ne\\_ispolz\\_uetsya\\_502027](http://www.cnews.ru/top/2012/09/06/v_shkolah_ssha_ipad_vytesnyaet_pk_v_rossiyskih_pochti_ne_ispolz_uetsya_502027), (accessed on 13 September 2013) [In Russian]
- Garther, *Traditional PC Shipments to Decline 10.6 Percent in 2013, While Tablet Shipments Increase 67.9 Percent*, available at <http://www.gartner.com/newsroom/id/2525515>, (accessed on 13 September 2013)
- J'son & Partners: *Market Watch "Market for mobile application development"* [In Russian], available at [http://www.json.ru/files/reports/2013-08-07\\_Mobile\\_Development\\_MW\\_RU.pdf](http://www.json.ru/files/reports/2013-08-07_Mobile_Development_MW_RU.pdf), (accessed on 13 September 2013)
- RB.ru: *The experiment on introduction of e-book in high school ended in Russia* [In Russian], available at <http://www.rb.ru/article/v-rossii-zavershil-sya-eksperiment-po-vnedreniyu-elektronnyh-uchebnikov-v-sredney-shkole/7044167.html>, (accessed on 13 September 2013)