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Anytime, anywhere learning for improved education results in Russia

Case study by the UNESCO-Fazheng project on best practices in mobile learning

Approach: Bottom-up

Implementing organization: Harmony School, Russia

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Education 2030

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Education 2030

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Abstract

The Harmony School in Izhevsk is a regular municipal school located in one of the city districts of the capital city of the Udmurt Republic in Russia. Students come to Harmony school from different cultural and social environments, with various physical and mental abilities, and the school is eager to create the best conditions for learning and developing for each of them. In 2012, Harmony School took a part in the School of Digital Age project supported by the federal Skolkovo project and the Russian branch of Microsoft. The mobile technologies in the school are implemented as a tool for anytime and anywhere learning to differentiate and individualize learning to improve education results.

According to the school vision, mobile learning technologies should provide all students and teachers anytime and anywhere access to a variety of teaching and learning materials and digital instruments and students who are unable to attend classes should be able to continue their systematic studies. The mobile learning model should enable every student to experience independent learning activities in the digital educational environment and improve their educational results with new methods and organizational forms of teaching and learning. To implement this vision, the new school-wide teaching and learning practices including online/blended learning, mobile learning in the classroom and outside-classroom learning have been developed and used actively. The new in-school teachers' professional development model has become a crucially important element for the project's success.

Harmony School embarked on an ambitious five year plan to reinvent learning for the digital age. They are utilizing a BYOD approach with a digital educational environment and LMS solution. This case study details the deep planning, preparation and execution that went into the plan and offers practical guidance for the challenges faced, lessons learned and recommendations for those seeking to replicate their efforts.

Mike Lawrence, PowerSchool

Keywords:

blended learning, BYOD, LMS MOODLE, outside-classroom learning, flipped class, whole school innovation, education policy

1. Introduction

Municipal comprehensive school (Educational Complex) no. 97, also known as Harmony School, is located in Izhevsk, the capital of the Udmurt Republic, Russia, which is in the eastern part of the East European plain. Izhevsk is one the Volga region's major hubs of industry, commerce, politics, culture and education. It has more than 600,000 inhabitants representing about 100 different nationalities.

Harmony School has more than 2,000 students, and covers the full age range from 3 to 18. There are about 80 children aged 3 to 6 in the kindergarten, more than 900 in primary grades 1 to 4, 800 in the main school grades 5 to 8, and about 300 pupils in high school grades 9 to 11. About 200 teachers work in the six main educational buildings and the kindergarten, most of whom (about 90 per cent) are female. The school also has about seventy other employees who work in the school medical centre, the information centre, the cafeterias, the media centre, in school administration and so on. The average age of the entire staff is about 46.

Students come to Harmony School from a wide range of different cultural environments, and have varied physical and mental abilities. The school creates the necessary conditions for learning and developing for each one of them. Students spend a full day at school (from 8.00 to 18.00), attending compulsory (basic) and optional classes as well as after-class activities of their choice. They can choose among more than ninety different free supplementary and extracurricular education programmes. These include the opportunity to study different native (Udmurt and Tatar) and foreign (Arabic, English, French, German, Finnish, Italian and Spanish) languages. Harmony School provides a number of supplementary summer school activities for students during the long school holiday, including cultural and research expeditions, sports events, in-depth learning classes and other specialized schooling and recreation. That is why Harmony School is commonly called a full day and full-academic-year school.

The teachers and school administration, together with parents and the local community, have designed all the school activities to develop the self-determination, cognitive independence and creative abilities of all students. They strive to ensure continuity of education and a smooth transition between the elementary, main and high school, as well as the fullest possible merging of basic (compulsory) and additional (extracurricular) education. There are several specialized classes (for sports, music, foreign languages, mathematics, technology and so on). Students make different choices among these depending on their interests and abilities.

In 2007, Harmony School was admitted to the UNESCO Associated Schools Network. The school's pedagogical team has set itself the ambition of achieving a high quality of education that meets the educational needs of each student, and meets national and the best international standards. To achieve this, they work to make effective use of all the intellectual, pedagogical, material and technological resources available to them.

Digital technologies have always been considered in Harmony School as one of the valuable tools for school development. Computer science as a subject, and general use of computers and the internet as learning tools, have been an essential part of school life since the late 1990s.

In 2012 Harmony School, together with a dozen other schools from the different regions of Russia, took part in the two-year 'School of Digital Age' (SODA) project, which was supported technologically

by the Russian branch of Microsoft. In this project mobile technologies were seen as powerful tools for differentiating and individualizing teaching and learning.

The first step in the SODA project was to develop the school's vision of the place of mobile technology in teaching and learning. During the course of the project, a digital portal was set up at the school. This portal allows every student and teacher to obtain constant (24 hours a day, 7 days a week and 365 days a year) access to digital tools, teaching and learning materials, and necessary data, both at school and at home. Students and teachers have access to new laptops and tablets. Teachers have received additional training in learning how to operate the new equipment and use it in their classes. As a result, mobile learning began to take shape in the school.

Picture 1: Blended learning.

2. The model

2.1 Vision

All students who come to Harmony School have different talents, interests, intellectual and physical abilities. The school views digital technologies (or information and communication technology, ICT) as a tool that helps it to take into account the personal characteristics of each student, and differentiate, individualize and when possible personalize the educational process. ICT helps the teachers to use teaching and learning approaches that cannot be realized in the context of the paper-based environment of traditional academic work.

Harmony School's priority is to create the most appropriate conditions for each student's personal development, and provide age-appropriate learning methods, which match the student's style and preferences. The school team strives to create a school where all students and teachers learn, each student receives a quality education and each teacher is engaged in professional development. The key Harmony School priority is to preserve and strengthen the health and personal development of each member of the school community.

According to the school vision, all students and teachers should have access to a wide variety of teaching and learning materials and digital instruments at anytime and anywhere, to ensure that everyone has equal access to quality education. Students who for any reason are unable to attend classes (they might be sick, be attending a sports camp, a tourist trip, a research expedition, or participating in other similar out-of-school activities) should be able to continue their systematic studies. Teachers should be able to acquaint themselves with the results of the pupils' homework assignments before the next lesson starts. At the same time, mobile learning should enable every student to gain experience in independent educational work in the digital educational environment. The digital mobile technologies must improve the students' educational results by introducing new methods and organizational forms of teaching and learning in the ICT-enriched education environment. Digital and mobile technologies must be used to provide teachers with the tools to improve educational results and organize the educational process more efficiently. Routine operations for the collection and processing of information must be converted into a paperless format, and all data processing should be as automated as possible. Mobile learning should make it possible to withdraw the learning process from the classroom walls, and help shape students' ability to become lifelong learners and develop twenty-first-century skills.

There were a number of requirements in implementing this vision in practice:

- Ensure all participants in the educational process have access to digital equipment in the school, and constantly maintain and develop the mobile learning digital educational environment.
- Provide professional development and continuous support to teachers who must search for, select and/or develop digital learning materials. Help is needed to ensure teachers master the digital educational environment resources and instruments, and use them to test and implement new highly effective teaching/learning activities which are supported by mobile learning technologies.

- Transform the school's work and day-to-day teaching/learning practices by combining the potential of mobile technologies and effective teaching approaches to improve the students' learning outcomes.
- All these efforts have to lead to an increase in the students' motivation to learn and ensure a tangible improvement in their academic achievements.

The formation of a shared vision of the use of mobile learning involved all members of the school community (Fullan, 2009). It was discussed not only by school leaders and teachers, but also by parents and influential members of the local community. The students also had a voice in this process.

2.2 School-wide planning

The school started to systematically use mobile technologies to improve the educational process in 2012, when it received support from the SODA project. A previous school development plan had focused on the use of ICT in the educational process, and the mobile technology project was based on the experiences in that project and the digital environment it created. The project became an integral part of the general school development plan, which is systematically developed and updated. Mobile learning has become the essential part of the project. (West, 2012)

The entire school community took part in preparing for and implementing the new project. As a result, using mobile technologies in the educational process became one of the dominant features of everyday school life. Each of the school subject laboratories presented its vision of using ICT in the curricula. Parents and the local education authority supported the school initiative. The school pedagogical councils were involved in discussing and approving all key decisions.

During the first stage of the project, from 2012 to 2014, the school acquired and began to use new computers, software, digital resources and other equipment. All teachers who wanted to participate in the project received mobile devices and additional training on ICT use, instructional design, and the operation of blended and online learning. The Harmony School teachers studied successful experiences of using mobile technologies in other schools, and visited the British Educational Technology Tradeshow (BETT). On this basis they developed mobile learning materials, and tested new approaches and teaching techniques. They carried out an evaluation and a comparative study of the new pedagogical practices that had become available in the digital environment.

During the second stage, from 2014 to 2018, there was a rapid expansion in developing and using online and blended-learning materials. A Foresight Session was held at the school to identify new mobile technologies that might be used in education over the next two to five years. Sessions like this give the participants the opportunity to imagine and agree on their desired future. Together they identify future events and locate them on a time map. They design the activities in a way that will reinforce positive trends (increase the likelihood of desired events) and reduce the impact of negative (undesirable) trends. This helps to determine what the school should prepare for, and what equipment it might purchase in the near future.

Teachers' professional development continued to support them in using digital methods and resources in the everyday teaching and learning process. The number of teachers who received additional training in mobile learning grew rapidly. During the academic year more and more teachers shared the methodologies they developed, their experience of using digital technologies in the teaching/learning process, talked about emerging difficulties and worked out ways to overcome them with colleagues at weekly meetings in the school subject laboratories.

Teachers from the school regularly shared their achievements with teachers from other schools in Izhevsk and other Russian cities. They reported and

conducted master classes at local and all-Russian educational conferences. They also continued to study best practices in mobile learning, and got to know what schools were doing in different countries.

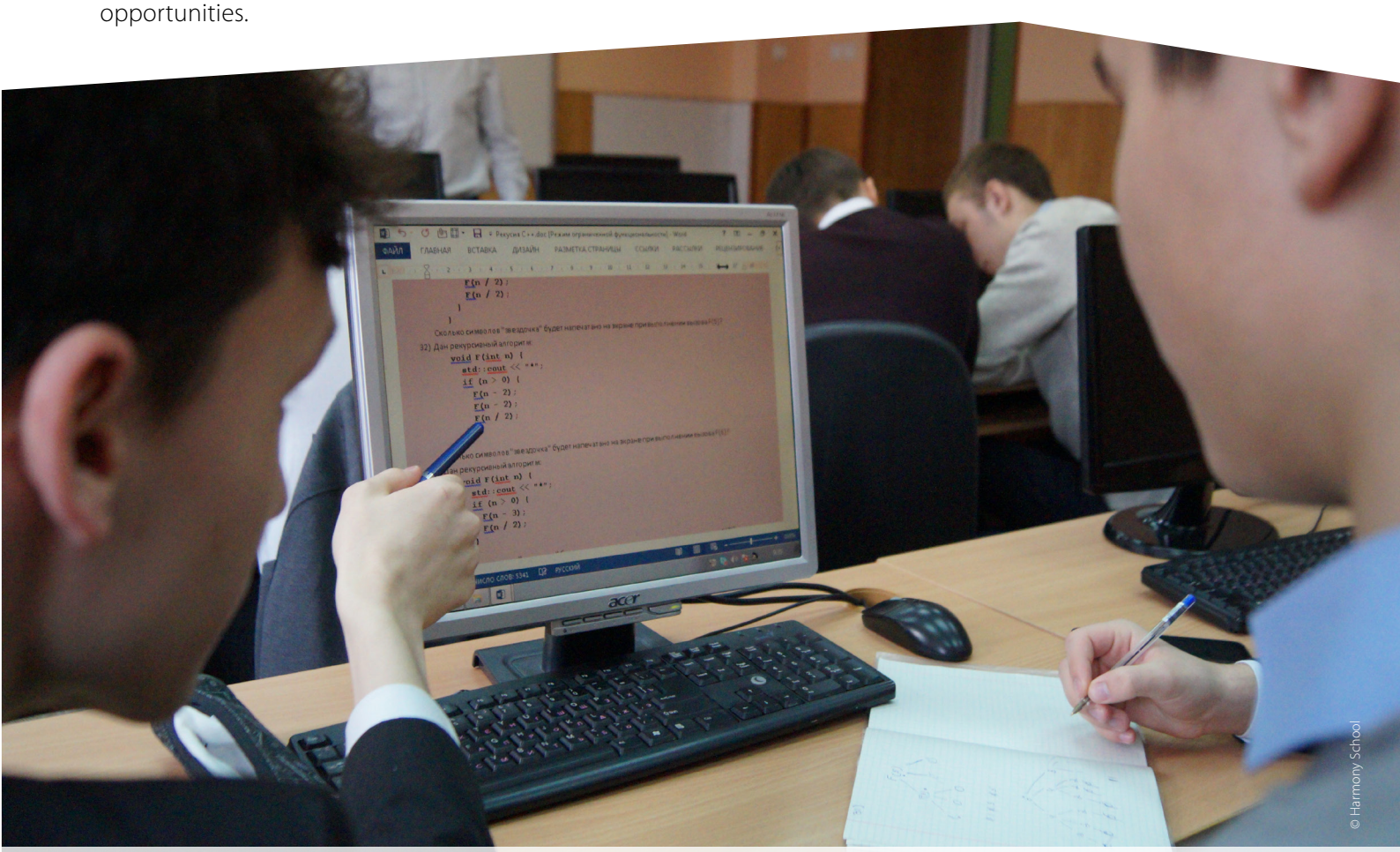
This experience has shown that to ensure that most school employees, including teachers, the administration, the medical-pedagogical centre and canteen workers, begin to use a constantly evolving digital educational environment in an everyday manner takes about five years.

Nowadays all Harmony School teachers have come to understand the importance of innovations, and have showed a willingness to learn and to change their traditional methods of teaching. The school systematically updates its mobile learning development programme to take into account new challenges, and the emergence of new tools and opportunities.

The next stage of the project, planned to run from 2018 to 2022, includes:

- continuing professional development for teachers, in the fields of individualizing the educational process and mobile learning
- the involvement of all teachers in this work
- the development and improvement of digital teaching materials
- an update of the school's digital education environment and redesign of the school website.

The school plans to modernize its distance learning software, and use augmented reality (AR) and Internet of Things (IoT) technologies as new tools for mobile learning.



Picture 2: Using a computer on math class.

2.3 Mobile learning environment

The digital educational environment in Harmony School has constantly been enriched throughout the six years that the project has been running. This encompasses both developments in the technology used and growth in the use of mobile learning activities.

Digital equipment

The school has a high-speed local area network which connects all school buildings. Teachers use a 100 MB connection and each student may use a free 25 MB connection to access the internet for all their needs, educational and otherwise. Free Wi-Fi access to the network is available in three school buildings.

There are interactive boards or multimedia projectors in the classrooms. A number of trolleys each holding twenty-five netbook computers are used to provide mobile classes in the elementary and middle schools. Among the peripheral equipment available for use are scanners, printers, digital cameras and a document camera. The school has two classrooms dedicated to students with special needs, both equipped with appropriate digital equipment. One classroom is equipped to teach hearing-impaired people to drive a car.

There is a school media centre where students have free access to computers, digital materials and instruments. The computers located in the media centre are available for students to use at any time.

Specialized computer classes and laboratories for robotics are equipped for the study of computer science and technology. There is also a specialized classroom equipped with computers for foreign language studies.

The school has an educational television studio where students prepare programmes for in-school use and for broadcast on the local television channel.

The school has a 'bring your own device' (BYOD) policy for all grades. Each middle-school and high-school student has at least one personal mobile device (a notebook, tablet or smartphone) that they use for learning purposes. Most primary school pupils also own personal mobile devices.

All teachers have access to personal laptop computers and tablets. They make extensive use of Skype, G suite and other cloud services to work together.

The school uses the commercial information management system IMS NETSCHOOL for routine records of the students, and the corporate employee portal recommended by the local education authority. LMS MOODLE supports the distance learning and all the lesson materials that teachers prepare for all subject areas in grades 2 to 11. Data on the educational materials that students have studied, the exercises they have done and the control tasks they performed in LMS MOODLE are transferred to the students' database, which is supported by IMS NETSCHOOL. Teachers also use the interactive voting system VOTUM® to obtain feedback from each student and collect information for reports on their learning.

Digital educational resources

Teachers and pupils at Harmony School use open digital educational resources (OER) from the state educational platform Russian Electronic School, the national Unified Collection of Digital Educational Resources, the All-Russian E-school and interactive educational platforms like uchi.ru. Teachers also use some OER from various other regional and school collections of digital teaching materials. Materials from YouTube are also very popular.

The school regularly purchases and provides to teachers and students digital textbooks recommended by the Russian Ministry of Education for all subject areas. A collection of links to these resources is available on the school server.

Teachers often use educational computer apps such as Plickers, Kahoot, Quizzes, Wizer, Formative, Quizlet, Scratch, PictoMir, Tricider, FlipQuiz, the Burlington English system for English language study, the Open Space School course for memory development, the website generator Wix, and many others.

The teachers are also working hard to create their own digital learning materials. LMS MOODLE, which is held on the school server, contains training courses developed by teachers for all subjects in grades 2 to 11. The courses are used by students in the school, and are constantly being improved.

Security and privacy

All students are required to become familiar with internet safety rules and ways to protect their personal data, and learn netiquette during the compulsory computer science classes. Once a month, teachers also conduct compulsory training sessions with students on issues of information security, and discuss their behaviour in cyberspace. The school also works continually with parents to explain how to ensure their children's internet safety outside the school.

The school ICT department manages all the users' accounts using a private domain. Each of the users has their own username and password. All students use nicknames and avatars, avoiding the use of real names or photos, when they participate in virtual communities.

The school internet provider ensures that students have safe access to the global network, and filters the content provided in accordance with federal regulations.

2.4 Capacity-building and incentive strategy

Every teacher at Harmony School has a higher education diploma. Most teachers have between ten and fifteen years of teaching experience, and are highly qualified according to the national professional standards. Many of the teachers have been awarded honorary titles and professional awards. Five teachers became laureates of the professional skill competition Russian Teacher of the Year between 2013 and 2017. Therefore, all school employees understand well that continuous professional development is the key condition for successful transformation of the educational process.

Since 2010, Harmony School has been running a project on 'Intra-school professional development as a technology for developing the human resources of the organization'. Each teacher has a personal plan for their professional development. (Varlamova et al., 2017). During school holidays and in free periods at school, teachers undertake professional training activities to improve their skills. The topics are determined by the goals of the School Development Programme, and take into account the teachers' needs and interests. The school HR department coordinates training and mentoring plans, and updates them every three months, to ensure that employees continue to further develop their professional skills.

Teachers' professional development takes various forms. There are systematic professional development courses on preselected topics. Often these take the form of master classes, training sessions, or workshops led by well-known Russian teachers and winners of professional competitions. Certified trainers and specialists on Google, Intel and Microsoft educational programs often conduct classes on the use of ICT in education. Business games and communication workshops are also often held.

The main resource for continuous professional development is the Harmony School teachers themselves. The school believes every teacher should be considered a source of innovation. Everyone can share their best teaching practices, which they use every day and have perfected in some way. (Wenger, 1998). As a result, the school's teachers initiated a new form of experience exchange, called 'Workshops of Innovation'. Here they share their interesting findings, experience in using new online tools, web services, resources and mobile educational apps. At these workshops the teachers often discuss the digital educational resources they have developed. Workshops of Innovation are held at the school every two months. They usually take the form of open lessons, master classes or seminars.

Each teacher who starts working at Harmony School gets the opportunity to master the school digital environment, and gets to know about their colleagues' experiences before they start to use mobile learning technologies in their daily work.

The most successful teachers are given the status of mentor-teacher. They supervise the preparation of network materials and distance learning at school, help young teachers to master pedagogical design, and conduct master classes and training sessions for all other teachers (including those who visit Harmony School for professional development).

Teachers from the school often become members of professional network communities such as the Educational Galaxy of Intel, Community of Educators of the Udmurt Republic, Microsoft Partners in Learning, Pedagogical Council and Cambridge Teachers. They take part in online forums, network conferences and webinars, where the issues of using ICT in education and mobile learning are discussed constantly.

Many teachers take training courses on Coursera, FutureLearn, Universarium and other online educational platforms.

The Harmony School teachers actively share their experiences with colleagues, conduct web quests and educational webinars for teachers and schoolchildren from other schools in Russia, and talk about the problems of introducing and using mobile learning. (Gvozdikova, 2018b). Teachers often participate in closed communities of practice where they share their experiences, receive feedback and learn from the other participating teachers.

Harmony School regularly accepts delegations of teachers from other schools interested in the possibilities of mobile learning. The school's activities to encourage teachers' professional growth have attracted the attention of teachers from other schools in the city. Since 2016, teachers from educational institutions in Izhevsk and many other cities and villages in the Udmurt Republic as well as other Russian regions (Samara, Chelyabinsk, Moscow and so on) have visited the school. More than twenty teachers from the school have set up personal websites on which they put interesting information about their experiences and methods, and share their digital educational resources.

Educational tourism is popular in the Harmony School. Teachers regularly participate in educational excursions to Russian and foreign schools. Every year a few teachers have the opportunity to take up internships at successful schools in various Russian cities and abroad. The school's teachers have visited schools in Singapore, London, Cambridge, Helsinki and other places. Every year teachers of different subjects attend the BETT exhibition in London.

Many teachers from the school take part in the regional and All-Russian professional competitions at which contestants demonstrate their best practices in using ICT in the educational process.

The Harmony School teachers believe that in order to use mobile technologies effectively for teaching, the teachers themselves must use them successfully for their own professional development.

Teachers constantly use the school portal to collaborate with their colleagues and exchange messages and materials. They conduct peer reviews and group discussions online. This reduces the need for teachers to move frequently between the different school buildings. As a result, teachers have significantly increased their level of interaction and abandoned many of the weekly face-to-face meetings which used to be mandatory.

They began to master the 'flipped classroom' model by starting to use it themselves to prepare and conduct courses in professional development. For example, to master a new application, they first make themselves acquainted with it using specially developed video materials, instructions and examples. They then get answers to any remaining questions and analyse in detail the techniques for using the new application during face-to-face classes.

In the eight years from 2010 to 2018, the school's in-house training project has proved to be highly effective. Teachers participate in all the project activities that interest them. As a result, every teacher in the school has spent about 200 hours a year on professional development and systematic improvement of their professional skills. This is over ten times more than occurs with the traditional teacher training system.

There is a carefully developed support system to help teachers work effectively and creatively at Harmony School. It stimulates teachers who take the initiative, prepare and present innovative developments, discuss with colleagues and successfully use the new mobile learning technologies to improve teaching and learning. The school encourages such teachers in a different way, and creates all the necessary conditions to facilitate the development of new pedagogical tools and technical solutions.

2.5 School-wide mobile learning practices

The implementation of mobile learning at Harmony School was aimed at improving access to quality education, and enhancing learning outcomes and the development of twenty-first-century skills. It was intended to enrich collaborative learning opportunities and help students to become independent learners. There are three main new models in use: online/blended learning, the flipped classroom and learning beyond the classroom walls. Each of the new models of academic work used in the school contributes to the achievement of the goals in a different way. Mobile technologies are also used widely for the professional development of teachers.

Online/blended learning

A number of Harmony School students are deeply involved in sports or music, in which they take specialized classes. Students in different grades go on multi-day excursions and expeditions, in term time as well as during the holidays. About twelve students every month on average are absent from school owing to illness, and occasionally the school has to close because of quarantine or severe weather. In all these cases, Harmony School students can continue their studies without coming to school.

Teachers develop and place in LMS MOODLE the learning materials, (lectures, stories, interactive exercises, practical activities, tests and so on) for each lesson. These materials have now been developed for every academic subject for grades 2 to 11.

The development and updating of these materials constitutes the bulk of teachers' work in preparing for lessons. Teachers prepare study materials and assignments in full compliance with the curriculum and current educational standards. In the course of this work, the teachers widely use electronic textbooks and various OER from the internet, including interactive learning environments, video

and audio fragments, quizzes and tests. They shoot video lectures and demonstrations, and plan and organize students' collaboration (for example, using Google tools) when necessary.

All students have access to online learning materials for their courses. These materials are permanently available via the internet at school and in their homes using mobile devices. Assessment of students' learning is carried out interactively, using peer assessment or direct teacher assessment. Teachers receive regular progress reports with online materials and assignments for each student. They answer the students' questions, carry out formative and summative evaluations, and conduct individual and group counselling online when necessary.

Experience shows that a combination of blended learning and the use of online learning materials is a good way to foster the development of the students' learning skills. The school policy recommends teachers to use blended learning whenever it is appropriate.

In 2015, it was decided that all the school students should work from home (usually) one day a week (on a Saturday). They use online educational materials and learn independently according to their individual learning plan. They coordinate their work plans for this day with their teachers. The tasks and materials offered to them vary according to their learning achievements and difficulties. Students who have already mastered the basic material receive in-depth training in subjects of interest to them, or might prepare to participate in a competition. As a result, LMS MOODLE has become a widespread tool to support students' independent work. Over 90 per cent of Harmony School students and about 70 per cent of the teachers use the blended learning technique regularly.

Mobile learning in the classroom

For students to use their personal digital devices in the classroom can meaningfully enhance their learning and increase their engagement in academic work. (Gvozdikova, 2016; Gvozdikova, 2018a; Pislegina, 2017a; Pislegina, 2017b). Since 2015 teachers of various subjects have increasingly asked students to bring their mobile devices to class and use them for various purposes (such as preparing a joint presentation, building a mental map on the topic being studied, or carrying out an information search). During the classes, students are often given assignments located on popular educational platforms such as School-Collection.edu.ru, Uchi.ru, Stellarium.org, Quizzez.com, Kahoot.com and Piktomir.ru. More than a third of the school's teachers use the BYOD model in their classes today.

Teachers in the high school are now mastering the flipped classroom model. Students study new subject material at home online, preparing for the lesson in which it will be covered independently and at their own pace. Teachers place the necessary information (including video lectures, sections of the digital textbook, practical tasks and quizzes) on LMS MOODLE. In the classroom students draw on this preparation under the guidance of the teacher to carry out a further task: they disassemble information, solve problems, answer questions and perform creative tasks. About 12 per cent of teachers regularly use this approach in their lessons today. As a result, results have improved in subjects such as maths, science, Russian and English.

The flipped classroom model helps to activate learning. It gives students an opportunity to assimilate educational material more deeply and develop their critical thinking skills. A further outcome is that the number of high-school students who successfully participate in subject Olympiads has increased.

Outside-classroom learning

Mobile technologies are widely used in the school to improve the effectiveness of extracurricular learning activities. These are now known as 'mobile lessons'.

Teachers use excursions as a learning tool in biology, physics, literature, history, technology and other subjects. Before the excursion they develop lesson scenarios, individual and group learning tasks, and depositories for digitized materials (photos, audio and video recordings from the excursion site, interviews, feedback from participants and so on).

The places of interest that students visit include museums, botanical gardens, farms, industrial enterprises and exhibitions. At each location the students carry out assignments and collect data, then they prepare reports in groups. They play the role of reporter and find out the necessary information to complete their learning tasks. Most of them are based around interdisciplinary projects. When students study a new place they learn its history, geography, environment, and find out interesting facts about it. Now, mobile technologies have become an indispensable tool for preparing and conducting outside-classroom learning and projects.

Picture 3: Using an interactive board in a flipped classroom.

2.6 Achievements

The main goal of the mobile learning activities is to improve educational results, so these results are the main indicators for assessing the mobile learning implementation in Harmony School. Six key indicators were selected:

- school marks students get during the school year
- results in state exams taken at the end of the school year
- levels of functional literacy
- number of students taking part in Olympiads at different levels (district, city, all-Russian or international)
- number of students receiving awards at these Olympiads
- students' motivation to learn.

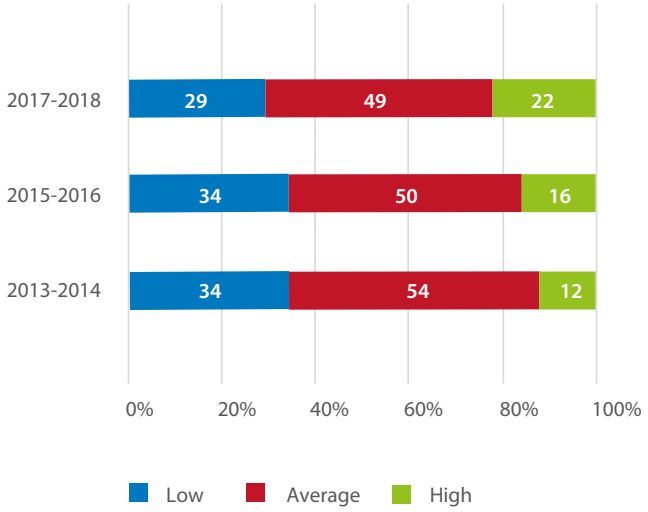
Analyses conducted by the school audit service show that the proportion of good and excellent assessments increased by 12 per cent between 2016 and 2018. Students began to get good and excellent grades more often.

The learning outcomes of students who are deeply involved in sports and music, and who have widely used mobile technologies for blended learning, improved from 2016 to 2018 by almost 40 per cent.

The results of state examinations in mathematics and the Russian language improved by 3 per cent from 2016 to 2018.

The school audit service tests grade 8 students using the Organisation for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA) project materials to assess their functional literacy. From 2013/14 to 2017/18 the proportion of students demonstrating a high level of functional literacy increased from 12 per cent to 22 per cent. At the same time, the proportion of students with a low level of functional literacy decreased from 34 per cent to 29 cent (**Figure 1**).

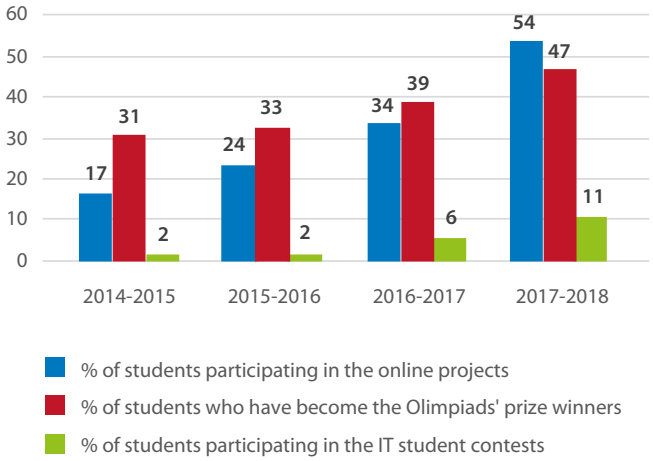
Figure 1. Change in the results of the 15-year-old students' reading literacy, 2013/14 to 2017/18 (based on the PISA demo study)



Source: Harmony School.

The numbers of students who take part in online projects, Olympiads and IT-related student competitions at different levels (district, city, All-Russia and international) have also grown (**Figure 2**). About 700 Harmony School students took part in such activities in the 2017/18 school year, and almost half of them won an award. Last year, the school team of programmers won the first place at the All-Russian programming contest for schoolchildren. Two teachers from the Harmony School became laureates of the 'I-Teacher' contest. More than 50 per cent of students took part in online projects initiated by the school teachers. All this suggests that the level of ICT competence of both teachers and students has increased because of the introduction of mobile learning.

Figure 2. Harmony School students' performance in online projects, school Olympiads and student IT contests, 2014/15 to 2017/18



Source: Harmony School.

The students' motivation to learn was evaluated by the method developed by N. Luskanova, which is widely used in Russian schools.[1] According to the survey, their motivation has increased. The changes were especially noticeable for the more difficult subjects (mathematics, science and literature).

A great achievement was the successful preparation of online lessons for all subjects in grades 2 to 11. The teachers have created and placed on LMS MOODLE over 1,500 lessons.

The spread of mobile learning has helped improve mutual understanding between teachers of different disciplines and students. They are increasingly using the digital environment for quick feedback.

The number of informational meetings and conferences that staff attend has decreased. Today, information is normally exchanged through network tools, and personal meetings are devoted more to analytical discussions and debates.

As the survey shows, the Harmony School students have realized the educational potential of mobile devices. They are increasingly using them not only for games and entertainment but also for educational purposes. The learning abilities of students have increased markedly.

The Harmony School, its leaders and teachers have more than once been given awards at the Russian professional contests on 'Innovation in Education' for the successful introduction of mobile learning into the school's practice.

2.7 Broader impact and sustainability

The successful introduction of mobile learning at Harmony School was made possible by the ongoing support provided by parents and the local community. There are representatives of the local administration and business on the school board. They assist the school staff in transforming teaching and learning practices. They share their experience in managing change in large organizations. The school has a development fund that helps it to hold professional development activities for teachers.

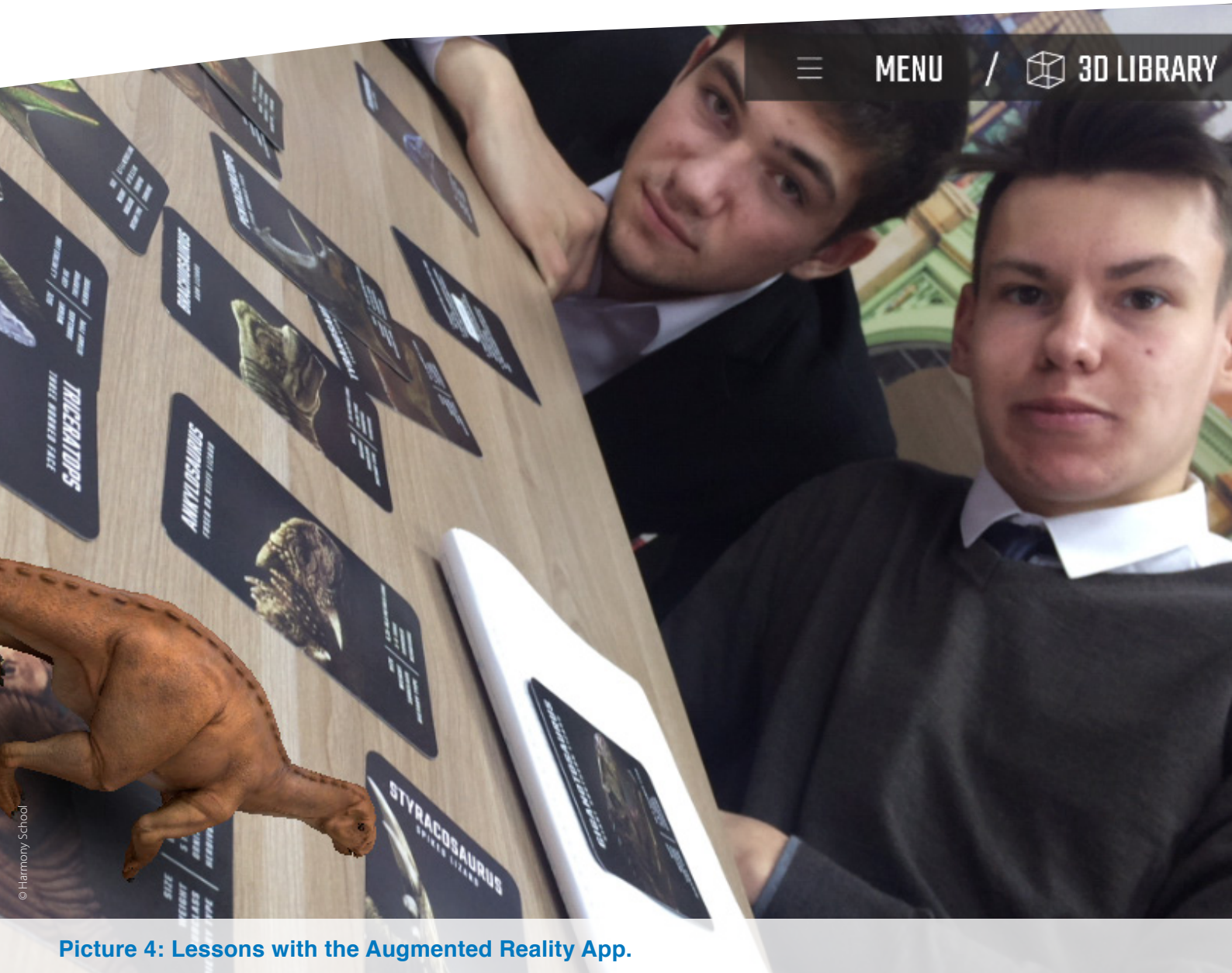
The school's teachers have held online workshops and master classes for teachers throughout Russia. The school team share their experiences and explain what worked well and what did not. The teachers also publish articles in Teacher's Newspaper (Uchitelskaia Gazeta, www.ug.ru), Headmaster (Director Shkoly, www.direktor.ru), Herald of Russia Education (Vestnik obrazovanyia Rossii, vestniknews.ru) as well as through professional network educational communities.

1 http://psylist.net/praktikum/00173.htm

The school regularly provides internships for teachers from the Russian Federation, during which its staff can share their experience of implementing mobile learning. In 2016 and 2017 the school provided full-time internships for the winners of the All-Russian competition 'Pedagogical Debut'. It was visited by teachers from the Kazan, Chelyabinsk and Samara regions, Moscow and other Russian cities.

As these experiences show, implementing mobile learning in the school is not a short-term project, but a long-term change programme. It includes not only the creation of a digital educational environment but a shift in the content, methodology and organizational forms of pedagogical work. This process combines the potential of continuously evolving technologies and constantly updated and improved teaching practices.

At the time of writing in 2018, five years after the start of the project, the digital transformation of Harmony School is continuing successfully. The changes that are occurring can be described as dynamically sustainable. The next step in development is expected to be a transition to personalized mastery-based learning.



Picture 4: Lessons with the Augmented Reality App.

3. Challenges and lessons learned

Implementation of mobile learning in Harmony School was not an easy journey. The school has encountered many challenges through the five-year project. Three of the most significant are outlined below.

- The first challenge related to engaging all members of the school staff and the entire school community in creating and achieving a common vision. Most of the experienced and successful teachers who worked at the school did not see the need to change their teaching practices radically. At the same time, it was clear that it would be impossible to succeed in introducing mobile learning without the support and engagement of a significant number of the teachers. Therefore, members of the project's initiative group, headed by the school principal, did a great job in convincing these teachers of the need for change. It was necessary to show them how using mobile technologies could improve and facilitate their work. Experts from the SODA project spoke at specially organized workshops. They talked about the potential of mobile technologies, and successful experiences of using them for teaching and learning at schools in Russia and abroad.

  A group of Harmony school teachers visited an innovative school in Kazan which had introduced mobile technologies. Other teachers learned about the experiences of foreign schools when visiting the BETT exhibition. This helped members of the school community to become interested in the project. The Foresight Session helped to involve most teachers in creating a common vision. As a result, the resistance to change decreased.

  Teachers continued to be involved in innovative work as the project went into operation. As a result, the number of teachers using mobile technologies grew, but even today some teachers make little or no use of them.

- The second challenge is related to development and support of the digital education environment.

  Building an up-to-date digital educational environment involves substantial costs that are not covered by the regular school budget. It is necessary to identify additional sources of funding to purchase and renovate expensive digital equipment. Finding enough money to provide a mobile device for each student is not easy. The school resolved this problem by settling for the well-known strategy of BYOD, but this caused a lot of additional difficulty. Software, digital tools and educational resources used at school had to be customized for work with all available types of devices, or replaced. The work of the technical support service has become complicated. Additional efforts were required to provide technical support to all teachers using mobile technologies. A special technology-training programme was developed for newly hired teachers.

  The school's digital educational environment continues to evolve. The mandatory part of this work involves preparation to train additional teachers and the development of materials so that staff can train themselves to use new digital devices and software.

  Preparing online learning materials and planning mobile activities was another major challenge. The initial hope was

that teachers would be able to confine themselves to digital textbooks and online educational materials, but this did not happen. The materials were initially insufficient and ineffective in use. At the same time the teachers did not have enough experience in selecting and developing high-quality materials. This new type of work turned out to be quite difficult for them. To overcome this problem, special classes were organized for teachers on learning design and preparing web-based learning materials. Many teachers mastered new ways of mobile learning by participating in network professional communities, online workshops and master classes.

The materials and services for teacher preparation offered by the Microsoft and Google teachers' communities were used widely. As a result, many teachers became Microsoft/Google Certified Educators. These qualifications were recognized by the school, and they became mentors to their colleagues.

Over the course of the project, the quality of network learning materials and ways of using distant learning technology have improved dramatically. More and more Harmony School teachers make wide use of mobile learning and new forms of educational work. Teachers share their mobile learning materials with teachers from other schools. This is a good incentive to improve their skills in using mobile learning technology and preparing online materials.

The main lesson the Harmony school project team learned during the introduction of mobile learning is that this kind of innovative work needs to make the greatest possible use of both teachers' and students' desire to innovate. The students can and should be full participants in the innovation process.

During the project, it became especially clear that traditional courses designed to upgrade teachers' qualifications are not effective and do little to help the innovation process. There is a need to transition to personal plans for professional development, closely linked to the plans for the introduction of mobile schooling. High-quality online learning materials are necessary. The traditional 'text and picture' approach used in textbooks is not enough. Online learning materials should be as interactive as possible, and help students develop their self-learning skills.

Another core precondition for the successful implementation of mobile learning technologies is for the school's digital educational environment to be reliable and convenient to use. To prevent and quickly resolve technical problems, the technical support service must be very friendly, and quickly resolve all the difficulties that teachers and students encounter.

4. Transferability

The innovations made by Harmony School are now widely known in schools in Udmurtia and beyond. The school has been designated one of the 'Distance Learning Centres of the Republic of Udmurtia'. Its teachers speak regularly to other teachers in Izhevsk and throughout Udmurtia. Every month the school conducts master classes and shares its experiences with teachers and school teams from Udmurtia and other Russian cities. As a member of the UNESCO Associated Schools Project, Harmony School also shares its experiences with other schools in the UNESCO network.

The director of the Harmony School is the chair of the Association of the Best Schools of Russia, which since 2015 has regularly provided internships for teachers at schools in different cities.

Many schools that have studied the experience of the Harmony School are implementing an in-school (in-house) professional development system for teachers,[2] and the one developed in the school provides a model. (Varlamova et al., 2017)

2 http://app.direktoria.org/konferencia/pub/7790

Picture 5: Learning about the Sustainable Development Goals.

The introduction of the school's weekly 'online learning day' created great interest among those who have studied the Harmony School experience. It is already being copied in several other schools.

Many Harmony School teachers prepare and lead inter-school telecommunication educational projects.

Many schools use online educational materials and methods that the Harmony School teachers developed and then shared.

Also of interest to many schools is the in-school monitoring and assessment system. Several schools have studied it and plan to draw on it in developing their own systems.

Picture 6: BYOD at an English lesson.

5. Conclusions and recommendations

Harmony School staff began to take an interest in mobile learning because they believed it promised to broaden the boundaries of the learning space, and extend it outside the classroom and the times of formal lessons. (Scott, 2015). The practical experience shows that this is possible. Mobile learning technologies can help to improve educational results if the whole education process is transformed to enhance students' capacity to learn.

However, giving all participants in the educational process free access to mobile technologies is not sufficient to achieve such a result. First, it is necessary to develop a well-functioning digital educational environment, to populate it with high-quality educational materials, and to provide all participants with a mobile computer, tablet or similar device. It is also necessary to change the organization of the educational process, to make active use of the various forms of blended learning, and to introduce a new system for planning and evaluating learning. All this is impossible without major changes in the work of the entire teaching staff, the active participation of parents, and the active assistance of the entire local community. It is not enough to plan and deliver additional training for teachers in the use of the technology. It is necessary to update the entire system for teachers' professional development and support, and help them to change their traditional teaching practices.

Implementing any time, anywhere learning is a complex long-term process which leads to change in all aspects of school life. But it seems to be the best way to systematically improve students' learning.

Harmony School is continuing to use new mobile learning technologies, and the results to date show that mobile technologies are a useful tool for improving school performance. Introducing them should be considered a long-term innovation project which will affect all aspects of the school's life. Those who are just starting this work should carefully examine the successes and failures of schools that began the process earlier.

To innovate in a school, the first requirement is to ensure the active support of all members of staff. Support is also needed from students, their parents, and influential members of the local community. Implementing mobile educational technologies is a long-term process that takes at least three to five years. When the school's experience is successfully transferred to other educational institutions, it can reasonably be judged to be successful and sustainable. Therefore, the dissemination of accumulated experience should be considered a mandatory part of the project.

The Harmony School experience has shown that successfully introducing and using mobile learning technologies helps to improve educational results and prepare a solid basis for a transition to competence-based personalized learning.

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Education Sector

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Education 2030

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