

# Pedagogical technology of using e-books in Kazakhstan

## Tecnología pedagógica del uso de libros-e en Kazajastán

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#### ABSTRACT:

There is a need to find the most effective ways to use digital technology in the learning process to implement the guiding principle of education in the 21st century, enunciated by UNESCO – "education for all." The article is to explore Kazakhstan's experience of using school e-books developed following Professor G. Nurgaliyeva's author technology, as well as to prove their effectiveness. The proposed technology demonstrated its effectiveness for development and use of e-books.

**Keywords:** e-books, digital technologies, learning effectiveness

#### RESUMEN:

Es necesario encontrar las formas más efectivas de utilizar la tecnología digital en el proceso de aprendizaje para implementar el principio rector de la educación en el siglo XXI, enunciado por la UNESCO: "Educación para todos". El artículo trata de explorar la experiencia de Kazajstán en el uso de libros electrónicos escolares desarrollados a partir de la tecnología del autor del Profesor G. Nurgaliyeva, así como para demostrar su eficacia. La tecnología propuesta demostró su efectividad para el desarrollo y uso de libros electrónicos.

**Palabras clave:** libros electrónicos, tecnologías digitales, efectividad de aprendizaje.

## 1. Introduction

UNESCO enunciated "education for all" and "lifelong learning (LLL)" to be leading principles of the twenty-first-century education (Delors, 1996) that serve to educate a cosmopolitan with a planetary mentality that would be able to perceive and implement the most progressive ideas and knowledge in the world. Kazakhstan is a country in the center of Eurasia, which gained independence after the demise of the Soviet Union 27 years ago. Kazakhstan education system inherited one hundred percent enrollment rate and basic curriculum content from the Soviet Union. However, this system was poorly oriented towards

equipping school students with necessary twenty-first-century skills and not sufficiently learner-centered. There are 7,047 state secondary schools in Kazakhstan, of which 5,348 (75.9%) are rural, including 2,944 (41.7%) underfilled schools. Features of underfilled schools are as follows: a small student population, one teacher giving classes on many subjects, students of different ages combined in one class, and a need for special formats of learning sessions. E-learning and digital technologies are being introduced in the country to solve these problems. The State Program for Development of Education in the Republic of Kazakhstan for 2011-2020 represents e-learning as one of eight focal areas aimed at improving the education system in Kazakhstan (Ministry of Education and Science of the Republic of Kazakhstan (MES RK), 2010). Under the State Program, new infrastructure is established in schools, teachers are trained, and digital educational resources are developed. Currently, the country is implementing the State Program "Digital Kazakhstan" aimed, among other things, at updating the education system following international best practices. Currently, 98.7% of schools are Internet-connected, 61.7% of schools have access to broadband Internet, with an average of 11 students per computer (MES RK, 2018).

Many researchers confirm that, through the use of digital technologies, the traditional educational process is transformed into students' cognitive activity on acquiring knowledge and skills on a subject they study as well as universal ones – the ability to search, select, analyze, organize, and present information, to use the information obtained to solve specific real-life problems and for remote interaction methods, etc. (Demirey, 2010; Daniel & Woody, 2013; Embong et al., 2012; Rockinson-Szapkiw et al., 2013).

At the same time, there is a growing concern in the world community about steps taken to digitize education not producing the expected positive results (Choppin & Borys, 2017; Chou, 2016; Means et al., 2014).

The authors assumed that it was not enough to digitalize education content and upload it on the Internet. Pedagogical design of e-books should take into account pedagogical patterns and stages (components) of the learning process: motivational-targeting, content, operational-activity, and evaluative-resulting components (Nurgaliyeva & Artykbayeva, 2010). The motivational-targeting component of the teaching and learning process is implemented through an e-book module. The content component is implemented through multimedia explanations and text-based material. The operational-activity component is implemented through various types of interactive tasks. Test programs represent the evaluative-resulting component. Sequential mandatory completion of all the stages of this pedagogical technology through learning with e-books ensures high efficiency of the teaching process and its effectiveness. The research objectives included testing the effectiveness of this technology in real school practice.

Several experiments on introducing e-books in real school practice were conducted, whereby the effectiveness of this technology was confirmed. The article describes the experimental results in the East Kazakhstan Region.

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## **2. Literature review**

E-books were developed in several stages. At an early stage, e-books were considered to be an additional resource of multimedia teaching rather than a replacement of print textbooks. This type of e-books was developed with multimedia software or HTML and delivered via a website or CD-ROM. The next stage was to develop publicly available online-books using special generators. Digitization of the existing printed books as replacement textbooks is most extensively used, but interactivity and learning support are limited in these e-books (Gu et al., 2015).

Most often, foreign researchers consider the experience of developing and using e-books at the higher education level (Bloice et al., 2014; Kouis & Konstantinou, 2014; Lau et al., 2018; Reynolds, 2011), while e-books for secondary schools are considered to a much lesser extent (Gu et al., 2015, Weng et al., 2018).

Most researchers regard e-books as a more advanced teaching tool than print textbooks, as they include multimedia and more interactive features (Choi et al., 2011; Lee et al., 2013),

are distinguished by flexibility, accessibility, interactivity, and extensibility (Daniel & Woody, 2013; Murray & Perez, 2011), as well as usability, higher cost efficiency and they are better at supporting training activity monitoring (Embong et al., 2012). Many papers prove that the effectiveness of e-books is not lower than that of print textbooks. Students who used e-books in the study had significantly higher perceived affective and psychomotor learning than students who chose to use traditional print textbooks, they learned actively, and they liked it (Rockinson-Szapkiw et al., 2013); new resources do not only extend the functionality of the older ones with an increasing efficiency but also allow for qualitatively different forms of interaction between the user and the environment by means of new types of user interface or prompt feedback about user activity (Fletcher et al., 2012; Ruthven, 2018).

Chen & Sun (2012) argue that visualization of knowledge through video-based multimedia material, animated and interactive multimedia material yields the most positive cognitive and emotional results because it includes auditory and visual stimulation. Meadors (2012) is committed to a verbal/visual combination of multimedia—specifically text and pictures with screen-capturing software. Researchers acknowledge that e-learning offers many advantages over conventional teaching methods, interactive e-learning provides a higher motivation for learners by presenting content in an interactive, game-based and competitive environment.

At the same time, some scholars doubt the effectiveness of the use of multimedia materials in teaching and believe that just adding media formats to teaching does not guarantee improved learning. Chou (2016) concludes that students prefer print textbooks over their digital counterparts. The lack of notable results obtained from the use of innovative functions of e-books is pointed at by Means et al. (2014). Choppin & Borys (2017) believe that the expectations placed on the effect of using e-books have been missed and many of these efforts have been unsuccessful because digital resources fail to meet teacher and student interests and needs.

Indeed, the attitude of teachers towards the use of e-books is also ambivalent. Although many of them tend to agree that digital content is useful, they also point out to a lack of time to learn how to integrate heterogeneous resources (Hanson & Carlson, 2005) and they prefer digital resources developed as small lesson segments (Clark-Wilson et al., 2014).

Burch & Good (2014) raise the issue that in many cases when schools procure content embedded in management systems, they lose control over the software content and, therefore, over the curriculum, whereby the provider determines the content. Besides, Burch & Good note a lack of motivation in providers to spend money on high-quality content development, which results in the content in poor quality of the content of many digital syllabi. When using online e-books, students can also encounter problems related to Internet bandwidth, both in access from school and from home (Saltman, 2016).

Research results by Lau et al. (2018) show that most sample e-book education materials are only suitable for low to medium level of learning subject to Bloom's revised taxonomy. Most of the reviewed resources lack integrity and complexity to support teaching at a high level that implies a higher degree of interaction and cooperation between students and teachers on e-learning platforms.

Thus, scholars concur in the fact that further research in the development of e-books is needed to understand better and summarize the results of their effectiveness. Gu et al. (2015) believe that e-book developers often focus on the interface or technical aspects, but relatively few studies have focused on instructional design issues, such as structure, content, etc. Great importance is attached to the design of e-books taking into account pedagogical patterns, which affects the goals and methods of their use (Lantolf et al., 2015). Railean (2012) rightly believes that the teaching goal of e-books is not only to present but also to generate and maintain knowledge for the interdependence of cognitive, affective, and psychomotor objectives. The author proposed a metasystem design framework of the four elements that included e-learning context methodology, motivation, performance, and assessment. The framework should follow the principles of self-regulation, personalization, clarity, dynamicity, flexibility, feedback diversity, and ergonomics.

While the experience of Australia, the UK, Greece, Canada, China, Malaysia, Singapore, the USA, France, and South Korea has been studied by many authors (Gu et al., 2015; Choppin & Borys, 2017, Kouis & Konstantinou, 2014, etc.), the experience of Kazakhstan remained out of researcher view.

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### **3. Theoretical framework**

According to the activity approach (Vygotsky, Leontiev, and Halperin), the content of education is acquired, and human abilities and functions are formed during the student activities. In the education digitalization context, methods and modalities of teaching and interaction between a teacher and a student as educational actors undergo dramatic changes. The identity of a student and their active learning and cognitive activity becomes the center of learning. Interactive teaching methods are updated. The teacher is no longer the significant and only source of knowledge, instead, they turn into a tutor who does not only communicate input teaching information to the student but organizes the student's work with educational resources, the interaction of students with each other for educational purposes, provides advice and support to them if necessary.

The textbook is considered to be not only a storage medium but also a means of learning. Through the textbook, the student's cognitive activities are managed. Textbooks and teaching aids provide assignments, questions, and exercises, which is supposed to ensure the process of acquisition. That is why scientists interpret the textbook as an information learning model, or as a kind of educational process scenario that reflects the theory and methodology of the learning process. From this standpoint, the textbook should reflect the goals of learning, describe its content, and define a system of cognitive activities with educational material, forms of learning, and methods of control.

However, print textbooks and partly electronic ones mostly provide instructional information and do not show how to handle it. In order for a textbook to act not only as a source of information but also as a factor in student personal development, it should, in content, form, and design, be a projection of not only scientific knowledge but also of fundamental patterns of personality development in the learning process.

The performance with the use of e-books can be improved if the pedagogical design of e-books creates an information and educational environment that would cover the principal components in the process of education:

- Motivational-targeting;
- Content;
- Operational-activity;
- Evaluative-resulting.

These components reflect the fundamental pedagogical law: the process of education can be effective only if the student has a positive motivation to study a school subject, is aware of the learning objectives, and independently and entirely carries out learning activity that is consistent with the learning objectives. Principles of e-textbook design are the main didactic principles: scientificity, systematicity, consistency, accessibility, visibility, conscientiousness, a combination of learning with practice, etc., only at a new higher level supplemented by digital opportunities (Tazhigulova, 2000).

It is well known that doctrine will be truly useful only if it is active: however, intensely the student is saturated with information, if the knowledge received from outside does not become personally significant, there is very little chance that they will be ingrained in memory for a long time. That is why self-instruction is referred to as the highest form of educational activity. According to A. Diesterweg, "Development and education cannot be given or communicated to any person. Anyone who wants to tap into them should achieve this through their activities, on their own, by their effort. From the outside, they can only receive an impulse...".

Thus, the modular pedagogical technology of e-textbook development is governed by common and individual didactic patterns, including:

- Learning outcomes are directly proportional to the awareness of learning objectives;
  - Any training requires the interaction of the teacher, the learner, and the object under study;
  - Learning can be effective only when students are active, etc.
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## 4. Materials & methods

The difference of the authors' approach is that they neither consider e-books merely as digitized or pdf versions of print textbooks nor as different teaching kits to support the learning process. Professor G. Nurgaliyeva's pedagogical technology involves the sequential implementation of all the four components in the educational process (motivational-targeting, content, operational-activity, evaluative-resulting) in the e-book information educational environment and implements an automated learning process from setting goals to achieving results: a module – a hypertext – interactive tasks – evaluation of educational achievements.

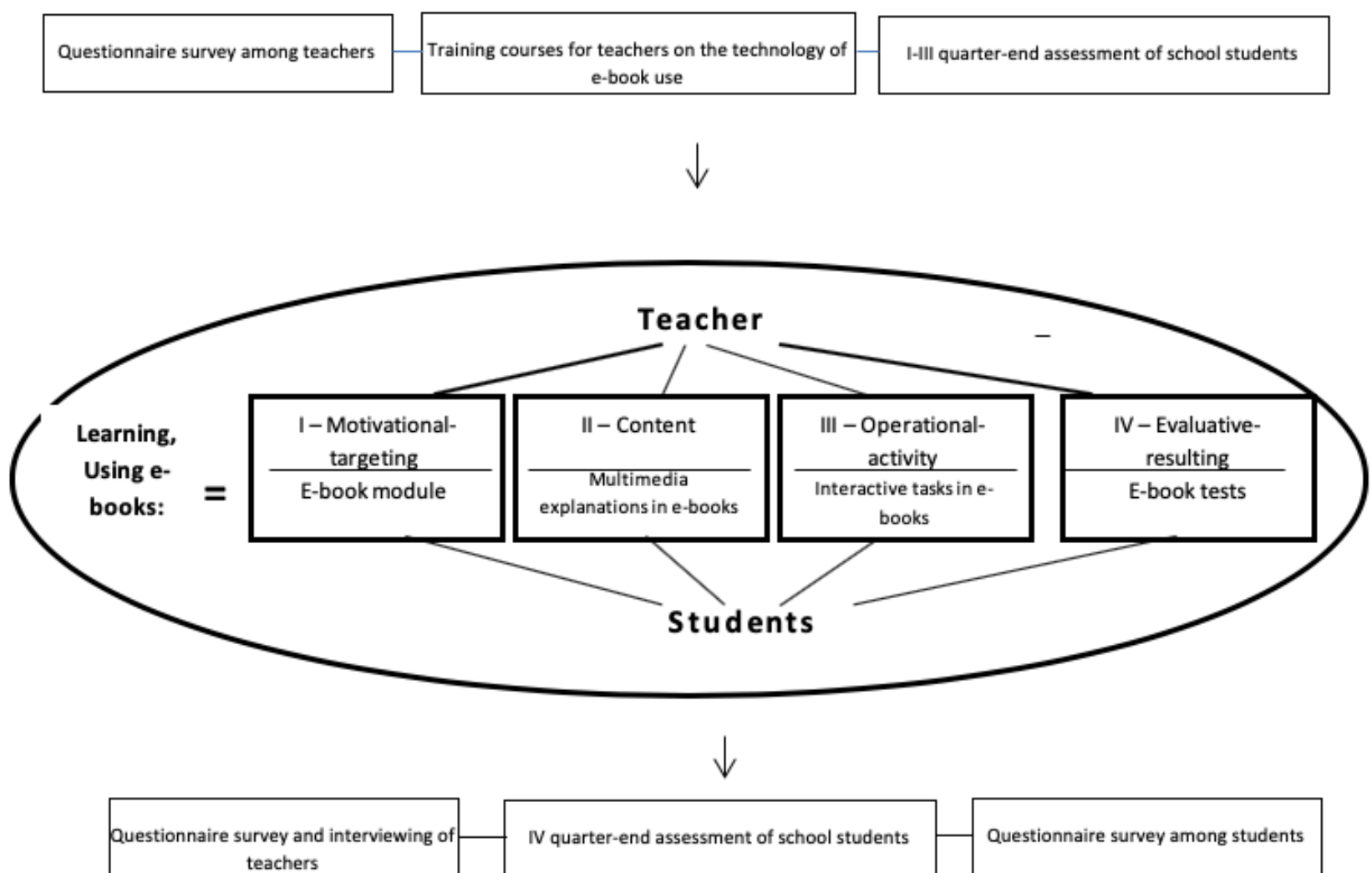
Based on this technology, the National Center for Informatization (NCI) developed e-books on mathematics, the Kazakh, Russian and English languages, geography, history of Kazakhstan, computer science, etc. Each e-textbook is developed by a large team of contributors that primarily includes scientists in a particular area of expertise, as well as practicing teachers, artists, designers, narrators, animation programmers, etc. An e-textbook for each grade on each subject is recorded on an individual CD-ROM.

The experiment on introducing e-books was conducted in 11 schools of the East Kazakhstan Region: five urbans, five rural, and one regional school. 203 classes took part in the experimental work, with 189 teachers of different subjects and 2,123 first to eleventh-grade students involved. The authors' keystone was the principle of voluntary participation of teachers; questionnaire survey results confirmed their desire to participate in the experiment.

In Kazakhstan, the academic year lasts nine months, from September to May, and is divided into four school quarters. The experimental class teachers used the NCI e-books in the fourth quarter (eight weeks long). Training by e-books in schools was carried out using interactive whiteboards, computer classrooms, multimedia language laboratories, and home computers (for homework). Lesson observation, questionnaire survey, interviewing, and statistical data processing methods were leading research methods. The experimental class teachers gave 2,097 lessons; 707 lesson notes and 227 video of lessons, workshops, and interviews with teachers, students, and their parents were submitted for analysis.

Before the experiment, teachers completed training courses to study the pedagogical technology of using e-books. In the course of experiment in class and for homework, e-books were used as an information educational environment that supported all the components of the educational process: I – motivational-targeting (setting goals using the e-book module); II – content (getting acquainted with new teaching material using multimedia explanations in e-books); III – operational-activity (consolidation of the learned skills and expertise with the use of interactive tasks in e-books); IV – evaluative-resulting (learner academic achievement control with the use of e-book tests) (Figure 1).

**Figure 1**  
Design of the experiment on using e-books



The efficiency of using e-books was assessed using a comparative analysis of student academic performance before using e-books and end-of-quarter grades after using e-books; a comparative analysis of students' end-of-quarter final grades in the classes with the use of e-books and classes without the use of e-books; a questionnaire survey and interviewing teachers, students and their parents to identify their satisfaction with and attitudes towards using e-books were also applied.

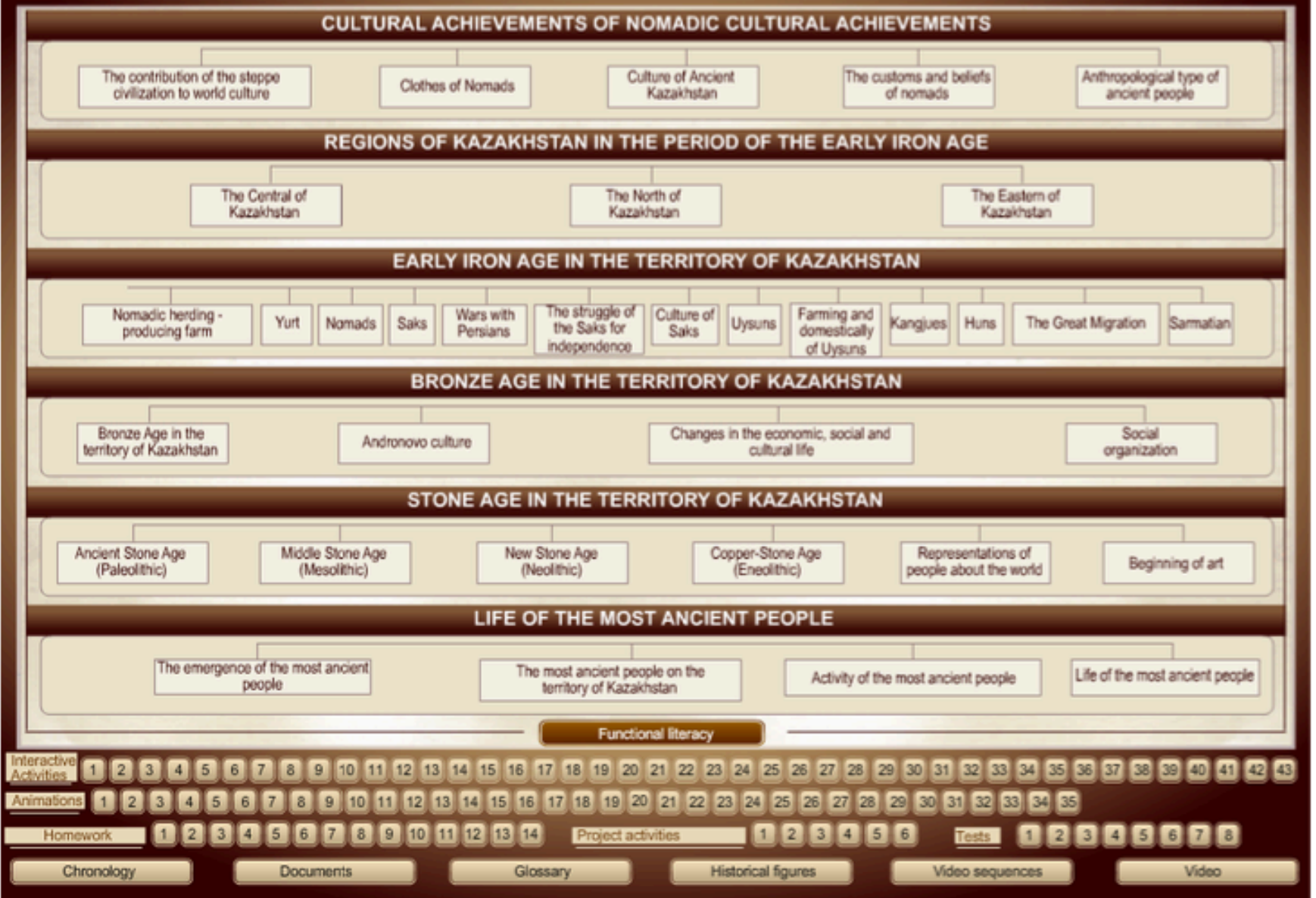
A percentage of student academic achievement is the total characteristic of student academic achievement in Kazakhstan. The quality of knowledge (knowledge quality percentage) reflects the level of student proficiency in a subject. The percentage of student knowledge quality in one class is calculated by a formula where  $n_5$  is the number of students studying with grade "5" (distinction),  $n_4$  is the number of students studying with grade "4" (merit),  $N$  is the total number of students. A five-mark grading system is used in the schools of Kazakhstan, whereby 5 is "excellent," and 1 is "failing".

$$KQ = \frac{n^5 + n^4}{N} \cdot 100\%$$

The authors' objective was to improve the quality of student knowledge by increasing the number of students receiving marks 4 and 5. According to the authors, this was facilitated by the use of the NCI e-books.

The learning process begins with laying the groundwork for learning motivation emergence. The core of e-textbook information educational environment is the module as a hierarchical body of local, functional, and system knowledge (Nurgaliyeva & Artykbayeva, 2010), see Figure 2.

**Figure 2**  
A module of the e-book "History of Kazakhstan, Grade 6"



The motivational-targeting component of the learning process with the use of e-books involves acquaintance with the module as a system of concepts and categories, as the language of a particular science, as well as elucidation of its value aspect. The subject syllabus content underlies the module following the State Standard of Secondary Education of the Republic of Kazakhstan.

The module is a hierarchical flowchart that creates an image of the expected result: what the student is to learn during an academic year. The learning objectives appear in a clear and visible form, which allows both the teacher and the student and the parents to have a clear idea and vision of the knowledge system that the student is supposed to acquire in the subject. A clear definition of the final and intermediate goals and objectives of educational activities also corresponds to the principle of student conscientiousness. Focus on the subject content as a whole allows the student to see the aggregate picture of educational material with all the interrelations. At the same time, student personality is formed that is capable of observing, analyzing, establishing cause-and-effect relationships, and drawing conclusions, which simultaneously contributes to the implementation of the educational principles.

Referring to the module in each lesson transforms the very goal-setting methods: now it is not the teacher who imposes a lesson subject, but it is students who determine the learning path in interaction with the teacher. Thereby, the inclusion of students in the process of effective goal-setting is ensured, whereby this activity is supported throughout all stages of educational cognition.

The module is a "functional unit" of the learning process organization because the names of topics in modules are hyperlinks that navigate to the actual textbook content. The module is referred to in each lesson. Therefore, knowledge of basic concepts and categories of a training course is practiced until it becomes automatic, without any special labor-intensive efforts, whereby it becomes a kind of "minimum basis" on the subject that is subsequently

borne in students' minds for life. Repeated reference to the module gives students an understanding of "information base," "database," "knowledge base" that is always underpinned by specific structuring. In this case, a pedagogical problem is solved, that is, a universal ability to work with information is formed, which is so highly demanded in the context of the information society.

The content component of an e-textbook is formed as a "database", a "knowledge base" and includes not only educational texts proper, but — most importantly for the secondary school — multimedia explanations of educational material, video clips, animated historical and geographical maps, photographs, voiced materials, primary sources, etc., which allows the student to immerse themselves in the subject area. While students only read texts when working with print textbooks, in the context of e-textbook information educational environment they somewhat "live through" the visualized text, observing the processes under study and studying objects that are not available for direct view in class. An animated presentation of theoretical material through graphic visual images, voiced by a professional speaker, has an effect on different sensory receptors, which contributes to figurative perception, comprehension and better memorization of material (Figure 3). Professionally voiced e-books facilitate student ability to speak with accuracy.

Student activities during work with multimedia explanations may include the following tasks: finding answers to questions posed by the teacher or the textbook; making a syllabus; writing out consequences of events, making a chronological table or a comparative table, retelling a text, etc.

Operational-activity component of the learning process is implemented through interactive tasks in e-books to develop student skills and expertise in a subject, as well as to ensure independent learning and personal growth, readiness to solve non-routine tasks, problems, and situations in various life spheres.

Interactive tasks involve the student in active work. Implementation of the interactivity principle through feedback and elements of live communication, as well as an adequate response to student actions, is an essential advantage of organizing a dialogue between the education actors in an information educational environment. For example, students must identify and transfer to the map the names of Neolithic settlement sites in the territory of Kazakhstan (Figure 4) or fill in the table accurately: match the keywords with respective periods of ancient history (Figure 5).

**Figure 3**

Multimedia explanation fragment from the e-tbook "History of Kazakhstan, Grade 6"





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**Figure 4**

Interactive task fragment from the e-book "History of Kazakhstan, Grade 6"



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**Figure 5**



the screen.

**Figure 6**

A test fragment from the e-book "The History of Kazakhstan, Grade 6."



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In pedagogical terms, it is essential that in the context of e-book, the teacher control is replaced by the student self-control. Thereby, adequate self-esteem is formed in students as a pivotal quality of information and communication personality.

Mandatory completion of all the learning technology stages with the use of e-books, that is, studying the module as a goal and multimedia explanations as content, interactive tasks and evaluation of educational achievements it ensures that students achieve the expected high-quality academic performance as a result.

In this case, e-books create didactic conditions for students to organize themselves for self-learning, to "live through" the educational process as its active participants, whereby the learning process takes on personal significance because it ensures the formation of individual experience of independent activity.

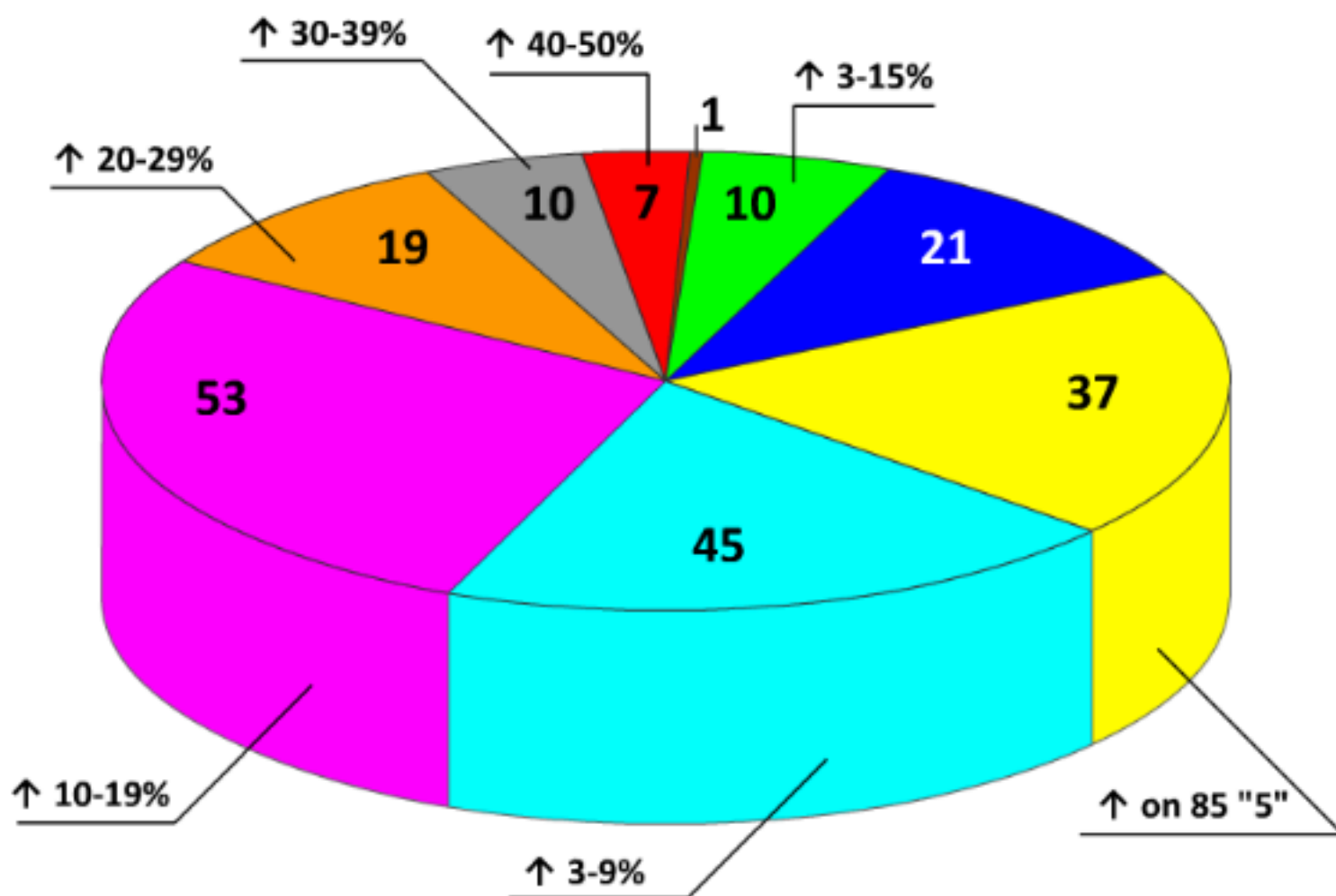
This enhances student motivation, as well as the formation of knowledge, skills, and expertise on the subject, resulting in higher knowledge quality, which is confirmed by the outcome of the experiment.

## 5. Results

Following the experiment, there was an increase in the academic performance quality in 135 (67%) of 203 classes, as shown in Figure 7. In particular, in seven classes, the academic performance quality increase ranged between 40% and 50%; in ten classes – between 30% and 39%; in 19 classes – between 20 and 29%; in 53 classes – between 10 and 19%; in 45

classes – between 3.5 and 9%. The most substantial growth of academic performance – by 66.8% – was observed in one class, grade 11A of secondary school No. 26 in Ust-Kamenogorsk, in English lessons.

**Figure 7**  
Performance dynamics in the experimental classes



In 37 experimental classes where the academic performance quality percentage remained the same, the number of excellent marks "5" increased by 85, which is also considered as a positive result of using e-books.

Comparison of the results in two eighth grades of Glubokovskaya secondary school named after Krupskaya is the most illustrative. The experiment took part in grade 8A comprising 20 students (12 boys and 8 girls). Learning with the use of e-books was applied in lessons in 10 subjects. In grade 8B with 18 students (9 boys and 9 girls), the same teachers taught without using e-books in the classroom. A survey showed that, in the period of experimental training, no students in both classes resorted to the help of tutors or additional extracurricular assistance from teachers. At the end of school quarter, it was found that in the experimental grade 8A there was a significant improvement in performance in all 10 subjects – in the range from 5% to 30%, as shown in Table 1.

In grade 8B, positive dynamics was observed only in five subjects and in a much narrower range: from 5.5% to 11.1%. In three subjects, the academic performance quality percentage remained the same, moreover, in two of them, the number of excellent grades decreased by 5. There was a decline in performance by 5.6% and 11.1% in two subjects, the number of failing end-of-quarter grades increased by 4. Thus, the growth in academic performance of the class that used e-books proved to be significantly higher compared to the class that was taught conventionally.

On average, the quality of academic achievement in experimental schools improved by 10%. The smallest dynamics of 2.7% was observed in the regional school for gifted children named after Zhambyl.

Development of an emotionally positive attitude towards studies in students and their motivated participation in learning and cognitive activity can also be considered an effectiveness criterion of the experimental work.

In the course of the experiment, a computer-based survey was conducted among the students in experimental classes in order to identify their attitudes towards learning using e-books. The questionnaire contained five statements they were asked to agree or disagree with based on the Likert scale (fully agree – 5 points, strongly disagree – 1 point).

**Table 1**

Comparative analysis of the performance data of grades 8A and 8B at Glubokovskaya secondary school named after Krupskaya (as % of performance quality)

No.	Subject	Grade 8A (using e-books)			Grade 8B (without using e-books)		
		I-III quarter	IV quarter	dynamics	I-III quarter	IV quarter	dynamics
1	English Language	35	65	↑ 30	55.6	66.6	↑ 10
2	Algebra	45	70	↑ 25	61.1	50	↓ 11.1
3	Russian Literature	80	100	↑ 20	61.1	61.1	0
4	Computer Science	85	100	↑ 15	77.8	88.9	↑ 11.1
5	Biology	80	95	↑ 15	72.2	83.3	↑ 11.1
6	History of Kazakhstan	70	85	↑ 15	61.1	72.2	↑ 11.1
7	Kazakh Language	65	80	↑ 15	66.6	66.6	0
8	Chemistry	50	65	↑ 15	50	44.4	↓ 5.6
9	Physics	40	55	↑ 15	55.6	61.1	↑ 5.5
10	Geography	95	100	↑ 5	82.4	82.4	0

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**Table 2**

The proposed template for statement assessment on the Likert scale.

No.	Statements	fully agree	partially agree	undecided	partially disagree	strongly disagree
1	With the use of e-books learning has become much more interesting.					
2	I prefer an explanation of new study material from e-books rather than from a teacher or a print textbook.					
3	The module of e-books helped me to understand the goals of studying the subject and interrelationship of topics					

<b>4</b>	After using of e-books, I began to understand the educational content better.					
<b>5</b>	Using of e-books helped me acquire practical skills (to do sums, to solve problems, to perform laboratory work, etc.)					

Table 3 shows the results of a questionnaire survey among the students in grade 8A of Glubokovskaya secondary school. 16 eighth-graders (80%) confirm that learning became much more interesting with the use of e-books. 12 students (60%) agree that they preferred to receive an explanation of new educational material from e-books rather than from a teacher or print textbooks. 16 students (80%) confirm that the e-book module helped them to understand the goals of studying the subject and the interrelationship of topics. 13 students (65%) report that after using e-books, they began to understand the educational content better, and according to 15 students (75%), using e-books helped them to acquire practical skills (to do sums, to solve problems, to perform laboratory work, etc.)

The authors identified whether there was a link between the common performance dynamics of eighth-graders and their attitude to the use of e-books, whereby Spearman's rank correlation coefficient was used. To solve this problem, first, the performance dynamics at the end of the experiment for each student on average and, second, the values of indicators of their motivated attitude to the use of e-books were ranked (Table 4).

**Table 3**

Questionnaire survey results for the students of grade 8A at Glubokovskaya secondary school named after Krupskaya

<b>Student</b>	<b>Statement 1</b>	<b>Statement 2</b>	<b>Statement 3</b>	<b>Statement 4</b>	<b>Statement 5</b>	<b>Overall score</b>
<b>1</b>	5	3	4	5	5	22
<b>2</b>	5	4	4	5	5	23
<b>3</b>	5	5	5	5	5	25
<b>4</b>	4	3	3	3	4	17
<b>5</b>	4	4	2	3	3	16
<b>6</b>	3	3	5	5	4	20
<b>7</b>	4	3	2	3	4	16
<b>8</b>	4	2	2	4	4	16
<b>9</b>	3	1	2	3	2	11
<b>10</b>	4	3	2	2	3	14
<b>11</b>	5	4	4	4	4	21

<b>12</b>	4	4	4	3	4	19
<b>13</b>	5	5	4	4	5	23
<b>14</b>	4	2	3	4	3	16
<b>15</b>	3	3	1	3	3	13
<b>16</b>	3	3	2	4	3	15
<b>17</b>	5	2	3	2	5	17
<b>18</b>	5	5	4	4	4	22
<b>19</b>	4	4	3	3	3	17
<b>20</b>	4	5	5	3	4	21

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**Table 4**

The results of ranking the dynamics of average student performance in grade 8A and their statements about the attitude to the use of e-books

<b>Performance dynamics ranks</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>
<b>Statement ranks</b>	2	7	5	1	3	8	4	6	15	12	14	9	18	10	13	20	17	11	19	16
<b>d</b>	-1	-5	-2	3	2	-2	3	2	-6	-2	-3	3	-5	4	2	-4	0	7	0	4
<b>d 2</b>	1	25	4	9	4	4	9	4	36	4	9	9	25	16	4	16	0	49	0	16

When values coincided, a correction for identical ranks was applied. In this case, the formula was as follows:

$$p = 1 - \frac{\sum 6d^2 + t_A + t_B}{n^3 - n}$$

where d2 is squared differences between the ranks; t A, t B are corrections for same ranks; n is the number of indicators involved in the ranking.

Spearman's correlation coefficient ( $\rho$ ) is 0.829 for these indicators. Thus, the relationship between the studied indicators is direct; the strength of the relationship on the Chaddock scale is high; the dependence of indicators is statistically significant ( $p < 0.05$ ). Consequently, there is a direct correlation between the use of e-books in the classroom and the positive changes in student performance.

Interviews with teachers and parents of students in experimental classes confirmed that e-learning in class and activities with e-books at home significantly increased the interest of students in learning.

## 6. Discussion

Choppin & Borys (2017) isolate four fundamental development trends whereby digital educational content is divided into four main groups: 1) comprehensive learning management systems include data reporting and classroom management systems; 2) adaptive programs mainly aimed at knowledge acquisition; 3) collections of lessons or content developed by small groups of authors, some of which are commercial corporations; 4) private sector version of curated content where a person or bot is used to select and organize content developed on the web and freely available. Following this typology, the authors' e-book design technology is more congruent with the third group, since an e-book for any grade on any subject can be referred to as a compendium of lessons with some assumption since it includes structured educational material on all topics of a training course. However, these topics are structured systemically rather than linearly through a single module from which individual topics are referred to. Accepted practice of storing collected resources on online platforms on specific topics (for example, <https://www.opened.com/search>, Khan Academy, LearnZillion, sofatutor.com, YourTeacher, etc.) does not comply with the principle of integrity and consistency essential for better acquisition of knowledge and for accomplishing learning objectives following Bloom's taxonomy.

Also, the authors' e-book design technology does not fully meet the classification of learning resources proposed by Lau et al. (2018) because it does not fully "fit" into any of the proposed categories. Professor G. Nurgaliyeva's pedagogical technology implies consistent implementation of all the four learning process components in the e-book information educational environment (motivational-targeting, content, operational-activity, evaluative-resulting) and implements the whole learning process from setting goals to achieving results: a module – a hypertext – interactive tasks – evaluation of educational achievements. Thereby, an e-book is an information and educational environment that implements the interaction between teachers and students through an e-book at a new level.

The NCI e-books also use the potential to introduce assessment, thereby providing feedback to students, as well as data on the quality of knowledge acquisition for teachers and parents (Choppin et al. 2017).

Like Pepin et al. (2017), the authors see a direct correlation between the design and use of digital resources: design technology determines the technology of their use. They fully agree that their crucial pedagogical significance for teachers is to change their teaching method through e-books, for them not to replace teachers but to improve teaching (Embong et al., 2012).

The use of CD-based e-books made it possible to avoid technical interruptions in access to their content, which had been indicated by many researchers (C. Weng et al., 2018). It is believed that in countries where access to the broadband Internet remains an issue, e-books should be delivered on CDs since communication lines cannot yet provide the multimedia content that is needed in high school.

The analysis of opinions of the interviewed teachers who participated in the experiment and mentioned that work with electronic books did not only increase the motivation for learning in children but also the motivation for creative work in teachers, infecting them with new ideas, was left beyond the scope of the article. The teachers' qualification in terms of information and communication technologies was improved: the teachers in experimental classes received certificates, learned how to embed the work with e-books in the structure of their lessons, using their didactic potential to achieve better results in learning. Having discovered the digital opportunities, they begin to create their presentations and slide shows together with students, to find interesting topics for projects using e-books and the Internet, etc. It indicates that the range of methodological tools of a teacher personality is significantly expanded, which also serves to improve the quality of education.

The issue of the fatigue of students in the classroom and at home when using e-books remained open and required further research.



## 7. Conclusion

The results of the experiment on the use of e-books developed using the modular technology show that the academic performance quality increased in all the experimental schools by an average of 10%; student learning motivation increased; a direct relationship between satisfaction with the use of e-books and the student performance dynamics was established.

The study shows that the use of e-books improves the quality of performance if they were developed following the educational technology of e-textbook design, which implements the overall learning process from a goal to a result and is based on the modular technology. Experimenting with introducing e-books in the real-world educational process at schools in the East Kazakhstan Region has confirmed the authors' hypothesis: learning using e-books effectively improves the quality of students' progress, is a means of developing students' abilities and promotes a conscious attitude to learning in them. This helps students to master content more easily and productively. It facilitates classroom management for teachers and supervision of children's learning process for their parents.

According to the authors, it is multimedia content that is essential for school education. The learning process in general education school is distinguished by some patterns and principles subject to the age specificities of children. Even broadband communication lines are not able to transmit and reproduce that ample multimedia material required for a fully-fledged educational process in schools. Due to CD-based e-books, e-learning becomes available to any student, including in small rural schools. Whether the school is situated in a remote village or a city, the use of multimedia e-books can give each child equal education opportunities to implement the fundamental twenty-first-century principle of education: "Quality education for all."

Suggestions for pedagogical design of e-books and conclusions about their use will assist the authors and developers of e-books with the design of digital educational content facilitating e-learning and enhancing the learning efficiency. Besides, this article will expand the geography of international studies, provide material for comparing approaches to the development of e-books in different countries, and contribute to the scientific community development in the field of education digitalization.

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