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The Impact of the Virtual Learning Platform EDUKA on the Academic Performance of Primary School Children

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Abstract: The modern teaching/learning environment is, like never before, rich with digital teaching/learning technologies and tools that are becoming part of children's daily lives. Background: In Lithuania, virtual teaching/learning platforms (environments for mathematics, knowledge of nature, history, and language practice) in primary education became more widely used approximately three years ago after the implementation and application of the virtual teaching/learning platform EDUKA. The purpose of this study was to establish the effect of the virtual teaching/learning platform *EDUKA* on the learning outcomes of primary-grade students in the subject of mathematics. Methods: In this study, a pre-test/middle-test/post-test experimental strategy was used to avoid any disruption of educational activities due to the random selection of children in each group. Mathematical diagnostic progress tests (MDPTs) are an objective way to measure skills and abilities. The MDPTs were divided into two sections: the tasks were allocated according to performance levels and the content, as well as fields of activity and cognitive skills. The assessment of all areas of activity was based on the primary school children's performance (i.e., unsatisfactory, satisfactory, basic, and advanced). Results: An analysis of the results of the MDPTs showed that, across the seven possible tasks, both male and female seven-year-old children achieved satisfactory results (results were observed between groups) (post-test: control gathering (CG) 5.10; test gathering (EG) 5.04; $p = 0.560$), basic results (post-test: CG 6.28; EG 6.42; $p = 0.630$), and advanced results (post-test: CG 1.90; EG 2.27; $p = 0.025$). The differences between the pre-test and post-test advanced ($p = 0.038$) and the pre-test and post-test basic ($p = 0.018$) levels were found to increase. Conclusions: It was found that intensively integrating the virtual learning platform *EDUKA* into formal education—specifically in the subject of mathematics—had a significant impact on primary school children's mathematical performance. In addition, after the experiment, a statistically significant difference was found ($p < 0.05$) in primary school children with higher levels. The intervention in the experimental group (i.e., integration of the virtual learning platform into the formal mathematics learning process) had a positive impact on access to mathematics. Students' math learning achievements were positive in progressive mathematics.

Keywords: virtual learning platform; mathematical literacy; primary education

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1. Introduction

1.1. Mathematical Literacy and Digital Learning

The rapid changes in science and technology have increased the value of information in the age we currently live in—i.e., the Digital Age. Rapidly evolving technology and the accompanying increase in the flow of information require a change in stereotypes and degree of knowledge with each successive and educated generation. In today's fast-changing and advancing world, where it is important to be able to quickly adapt to developing technologies and modern management methods, a citizen who has a good knowledge of mathematics and is able to apply mathematical skills, mathematical thinking, etc., is substantially more successful in a variety of fields (education, work, etc.). Today's world requires its citizens to have mathematical literacy skills in their day-to-day life as well as in the work force; thus, the main goal of teaching mathematics is to develop the basics of mathematical literacy in citizens as early as in primary education [1–3]. According to researchers, in the 21st century, it is considerably more important that a student learns to think, question. and find answers. find the required information, select it, then apply it. Mathematical literacy includes knowledge, understanding, and the application of mathematical knowledge and skills in solving a specific problem. Mathematical literacy includes problem solving, logical thinking, situation modeling, proper mathematical communication (argumentation, interpretation, critical appraisal), working with information, and more. Formal education in mathematical literacy begins in primary school. Quality mathematical literacy education in primary school forms a solid foundation for further higher learning achievements and learning success, which later lead to successful adaptation and further success in many areas of life (academic, work, etc.). The ability to quickly adapt to modern technologies, modern management methods, and respond to the expectations of a changing society is determined by mathematical literacy, because technology increases the need to work with numbers, requiring a higher level of mathematical literacy [3–6]. Domain-specific instruction theory for mathematics [7] emphasizes a constructivist approach to the conceptual understanding development of mathematics and to mathematics as a human activity. The theory states that only by re-inventing and rediscovering mathematical ideas will learners be active and able to move from the horizontal mathematization to the specific dimensions of mathematical ideas, i.e., vertical mathematization [7].

We analyzed the current learning situation of Lithuanian primary school children and found long-term stability, as well as average or low mathematical literacy achievements, which indicates a problem: unsuccessful learning. Based on a national survey of student achievement in 2014, the majority of class IV students achieved a basic or satisfactory level of achievement (58.5% and 25.6%, respectively), while only 11.8% achieved a higher level of achievement (Lithuanian fourth graders) [8]. According to the International Trends in Mathematics and Science Study (TIMSS) 2015, the results of Lithuanian fourth graders were slightly better than the EU average (536 points), but the achievements of Lithuanian 4th grade students in mathematics have remained stable for many years [9]. Next to mathematical literacy, digital learning and digital competency development have also become important. These types of learning are very adaptive and engaging, and they develop the principles of students in terms of acquiring the skills to learn autonomously for the rest of their lives [10–12]. Together with the emerging possibilities of learning more comfortably by using tools, nowadays, it is necessary to use attractive and advanced teaching/learning tools that generate the motivation for students to learn.

A growing body of research suggests that constructivist principles are fundamental to our understanding of learning in virtual reality learning [13]. The review of the literature shows that digital environments can support constructivist learning principles since they allow learners to control content, sequences, and learning strategies; learners thus can create their own discovery activities that encourage diverse thinking and problem representations, all of which help stimulate intrinsic motivation [14-16]. Within a constructivist paradigm, learners take an active role in their learning, since they connect it with previously assimilated knowledge to construct new knowledge [17] and attempt to reduce the gap between the learner's knowledge and a real-life experience [18] Important functional properties that can benefit learning in digital learning environments are spatial knowledge representation, experiential learning, engagement, contextual learning, and collaborative learning [19].

Lin and Chen [20] revealed that subject learning, with the assistance of digital learning, increases the learning time for students and relatively enhances their learning performance. Digital learning could provide alternative innovations for class teaching; however, teaching effectiveness could be enhanced merely when the system's functions are rich and diverse [20]. The meta-analysis by Hillmayr et al. shows that the use of digital tools had a medium and significantly positive effect on students' learning outcomes. The impact of digital learning on students' learning outcomes can be greatly enhanced by support from teachers or classmates [21].

However, in order to ensure quality education, additional knowledge and competencies in the field of information technology management are necessary. Researchers and educators share the same opinion as far as the aim of such technologies is concerned by emphasizing the need for a change from a teacher-centered learning model to a student-centric learning approach where learners can control their goals and monitor their progress [22, 23]. Considering the dilemma encountered in regard to mixed digital learning, school administrations could provide teachers with software and hardware support and assistance, according to their needs, in order to reduce the doubt surrounding digital learning and, with encouragement, encourage teachers with corresponding interests to form an organization similar to professional communities to promote digital learning. Teachers play a crucial role in developing the effectiveness of digital learning. In other words, the promotion of digital learning could provide alternative innovations for class teaching [20]. It is believed that, in the future, this form of teaching will be integral, so education in the field of information technology retains its importance—starting from primary education.

1.2. Integration of Virtual Teaching and Learning Platforms in Primary Education

Dillenbourg, Hong [24], Bogusevschi, Muntean [25], Rashid, Asghar [26], and Kondratavičienė [27] claim that the purpose of virtual teaching and learning platforms is to improve the content of the subject's curriculum and to help students study the material. According to researchers, virtual teaching/learning platforms present the opportunity to make the content of the subject available and to regularly update it with the newest information that reflects changes in education. In addition, it allows for announcing information related to teaching and learning, social interaction among students, their parents (carers or guardians), and educators (the communication takes place in discussions, forums, via email or other means of communication), provides innovative technology-based pedagogies (i.e., teaching/learning assistance and consultations, personalized learning paths through educational content, evaluations/self-evaluations and tracking of personal learning progress (practical tasks, tests, knowledge tests, and other activities)), and educational games. The use of educational games as learning tools is a promising approach due to the games' abilities to teach and the fact that they reinforce not only knowledge but also important skills such as problem-solving, collaboration, and communication [28]. All of these possibilities that come with virtual teaching/learning platforms make it possible to organize a modern teaching/learning process and seek quality education. In their research, Dhakal and Sharma [29], Zuber and Sulaiman [30], Pepin, and Gueudet and Trouche [31] found that teaching in the digital age requires teachers to be capable of interacting with digital resources in a curriculum. The researchers also noticed that the use of virtual learning environments in mathematics lessons made the education process more effective, the quality of educational content delivery was enhanced, the knowledge received was deeper and the students reached higher learning outcomes [29–31]. The increasing presence and relevance of Information and Communications Technology in learning scenarios have imposed new demands on teachers, who must be able to design new learning situations while relying on the growing supply of available digital resources. It has become clear that if we understand competence as the capacity and eagerness to act, we need to consider not only conceptual understanding but also skills, values, beliefs, and attitudes. This is especially true in the case of Education for Sustainable Development, whose focus is on transformative learning [32].

Laakso, Kaila, and Rajala [33] created a digital learning path that covers the first nine educational grades (ages 6 to 15) for the online platform Eduten Playground [33]. Eduten Playground (in Finland known as ViLLE) is an exercise-based learning environment for mathematics, programming, and language practicing. Eduten Playground brings together various elements that can promote learners' self-efficacy and regulation of learning, increase motivation, and strengthen performance. In addition, the freedom offered to teachers to create and share their own exercises—tailored to their needs and teaching approach—differentiates the aforementioned platform from other available solutions that are more restrictive when it comes to content customization and personalization. To this end, the inclusion of the learning analytic dashboard further enables teachers to identify students who are not making adequate progress and, thus, are in need of additional support [22].

Noting that the application of information digital technologies, virtual learning platforms and other innovative tools in the educational process has been widely applied and researched by many scholars in various countries, according to Kondratavičienė [27]. In Lithuania, especially at the primary level, various digital technologies, virtual learning, and the integration of platforms in the educational process is not as widespread as in other countries. In Lithuania, virtual teaching/learning platforms in primary education became more widely used approximately three years ago with the implementation and application of the virtual learning/assessment platform EDUKA. The learning/digital assessment platform EDUKA is an innovation of local novelty in Lithuania, designed for students and teachers in order to optimize, modernize, and support the teaching/learning process. The virtual teaching/learning platform, adapted to the Lithuanian context, is distinguished by the possibilities of individualization and differentiation of education [27]. In 2020, EDUKA, an original teaching/learning digital environment created in Lithuania, was recognized as one of the 50 most innovative educational start-ups in the Nordic and Baltic countries in the category of learning resources and environment at the annual Nordic European HolonIQ Nordic-Baltic EdTech Awards. EDUKA, which is purposefully designed for the country's schools, combines two subsystems: classroom and gradebook. EdukaClassroom and EdukaGradebook have integrated functionality: (1) a library of digital resources with more than 400 digital textbooks, more than 25,000 different types of digital assignments, diagnostic, and pilot tests, and other useful information for teachers is provided, and its content is continuously updated; (2) the learning organization function is used by teachers to prepare their lessons, collect and store teaching and methodological material in their account, use EdukaClassroom resources and supplement them with their own solutions (e.g., using Padlet, Canva or other digital tools), tailor subject content according to individual student abilities, and create original tasks and tests of different complexity and different types; (3) the group creation function allows the teacher to divide the students into groups according to a planned goal, thus creating preconditions for students to perform in groups, encouraging their interaction and cooperation; (4) the communication and feedback function allows the distribution of individually prepared learning materials and tasks to a student or group of students, wherein students can independently study a topic in more depth, then complete a task and immediately obtain feedback; (5) the progress monitoring and data analysis function of EdukaGradebook allows teachers to collect and analyze large amounts of data, helping them to make timely learning improvement decisions for a specific student or group of students with similar characteristics.

According to Drijvers [16], successful integration of digital tools in mathematics education is a subtle, promising issue, waiting for its full exploitation, which will require close collaboration between teachers and researchers.

Therefore, we formulated the following research hypothesis: The application of the learning/assessment digital platform EDUKA has a positive impact on the improvement of mathematics learning achievements of primary school students.

The purpose of this study was to establish the effect of the learning/digital assessment platform EDUKA on the learning outcomes of primary-grade students in the subject of mathematics.

2. Materials and Methods

2.1. Participants

The schools utilized in this examination were randomly chosen from elementary schools in Lithuania. Four schools were chosen from different districts of Lithuania, and they were ordinary in the Lithuanian education framework, i.e., the state framework, working as per the depiction of essential, fundamental, and auxiliary education programs endorsed by the Lithuanian Minister of Education and Science in 2015. It should likewise be noted that these schools structure classes without applying choice rules; in this manner, it very well may be said that the pupils in the randomly chosen classes were additionally arbitrarily doled out to the control and experimental groups. A non-probabilistic accurate example was utilized in the examination when subjects were incorporated, relying upon the objectives of the investigation.

The examination information was gathered from September 2018 to May 2019 out of four Lithuanian general education schools that had essential education classes. The control group involved 43 girls and 46 boys aged 6–7. The experimental group contained 45 girls and 44 boys aged 6–7 years. All pupils went to a similar school. The time and place of the examination, with the assent of the guardians, were settled upon ahead of time with the school organization. This investigation was endorsed by the research ethics board of the, Institute of Social Science, Arts and Humanity, Kaunas University of Technology (Protocol No. V19-1253-03). We used a test that was validated by theoretical, content, and statistical validation methods (the mathematical diagnostic progress tests) [34].

2.2. Instruments

2.2.1. Mathematical Diagnostic Progress Tests

The mathematical diagnostic progress tests (MDPTs) were setup as per the prerequisites of the General Mathematics Education Curriculum (affirmed by ISAK-2433, 26 August 26, 2008). Diagnostic progress tests are a targeted approach to gauge aptitudes and capacities. The MDPTs were isolated into two segments: the tasks were distributed by execution levels and the substance just as fields of action and intellectual abilities. The evaluation of all territories of action depended on the elementary students' presentation (i.e., unsatisfactory, satisfactory, basic, and advanced).

An advanced degree of achievement was achieved by those pupils who scored 26–33 standard points during the investigation; essential was achieved by those scoring 16–25 standard points; satisfactory represented 7–15 standard points; and unsatisfactory level was 0–6 standard points. These levels were depicted by the children's primary groups of operational capacities: mathematical information and abilities in performing standard strategies, mathematical communication, and mathematical reasoning, and critical thinking. Given these degrees of student achievement, the adequacy of the way toward getting sorted out student learning was evaluated. The degree of student achievement is a model for assessing the association of the learning process. This evaluation was utilized to investigate, decipher, and look at the connections between pupils' methods of getting sorted out learning and achievement. The four degrees of achievement are depicted as follows:

Basic level of achievement:

- Knowledge and aptitudes—the pupils see all of the essential mathematical ideas and perform standard mathematical functions without blunders.
- Relational abilities—the pupil effectively comprehends the states of the undertaking introduced distinctively and can take care of useful and mathematical issues in

different settings. They reliably, exhaustively, easily, and present the arrangement of the assignment.
- Thinking and critical thinking aptitudes—the pupil picks a successful and judicious problem-solving system. They can recognize and show the highlights normal for objects and phenomena and decide their fundamental as well as their extra relations or consistencies. The pupil makes nitty-gritty and precise determinations dependent on the right answer for the issue.

Satisfactory degree of achievement: Knowledge and abilities—the pupil applies the current information in new, straightforward circumstances, yet the information is not thorough. Relational abilities—the pupil effectively comprehends the states of straightforward reasonable and mathematical substance issues. The pupil fundamentally presents the arrangement of the issue effectively, utilizing proper terms and symbols; however, they need to learn precision, consistency, intelligence, and succinctness. Thinking and critical thinking ability—the child cannot use balanced critical thinking systems precisely and does not recognize or show all trademark highlights of objects and phenomena, only being able to recognize their fundamental relations or consistencies. They use examination blend, yet items and phenomena are not analyzed as indicated by the entirety of their trademark highlights.

Unsatisfactory degree of achievement: Knowledge and abilities—the pupil rehashes some information, yet the degree of information appreciation is shallow. They apply the fundamental standard systems characterized in the educational plan. Relational abilities—the child comprehends the states of the most straightforward undertakings accurately and attempts to pass on the fundamental thoughts and the arrangement of the issue. They lack comprehension of the reason for communication, mathematical ideas, and symbols. Thinking and critical thinking abilities—the child does not use level-headed critical thinking methodologies, but rather joins a few calculations in standard circumstances. They take accurate care of the issue and clarify its arrangement and the outcomes acquired; however, they do not give the final answer or reach the last inference required. The child perceives and analyzes just individual subtleties of the examination question without connecting them, does not see consistencies and associations, does not prove with coherent thinking, and does not contend or decipher.

Inadmissible degree of achievement: The pupil does not accomplish a satisfactory degree of achievement in any of the mathematical action capacity groups.

These degrees of children's learning achievements were analyzed in the investigation as per the rules of learning association proficiency, that is, methods of beginning the exercise, methods of introducing new material, methods of information appraisal and abilities arrangement, and association of criticism. Ultimately, the investigation utilized a measurable model to decide if the degree of pupil achievement relies upon the manners by which learning is coordinated [26].

2.2.2. Distribution of Mathematical Learning Achievements by Curriculum Content

Mathematical determination assesses first-grade children' mathematical information and aptitudes as per the five zones of the arithmetic education educational program:
1. Numbers and calculations
2. Phenomena, equations, and inequalities
3. Geometry, measures, and measurements
4. Statistics
5. Communication and general problem-solving skills

The MDPT was created by the necessities for the plan of the test and the subjective prerequisites for the assignments. The reason for the structure and the lattice of the test are given in its attributes: the assignments are dispensed relatively as per the degrees of student achievement (i.e., unsatisfactory, satisfactory, basic, or advanced), the substance of the subject of arithmetic, the fields of action (i.e., numbers and computations, wonders, conditions, disparities, calculation, measures and estimations, insights, communication, and general critical thinking procedures) and intellectual capacity groups (i.e., mathematical information and comprehension, use of science and higher reasoning capacities).

As per the framework of the created test, the pupils' achievement levels, the substance of the subject of arithmetic and psychological capacity groups, the hypothetically most noteworthy conceivable score was determined for each exploration zone—a hypothetical outcome that was utilized to evaluate the pupils' accomplishments in a specific field demonstrated by the MDPT's.

To guarantee the equivalent assessment of pupils' MDPT results, per the fields of action, MDPT assessment directions were utilized, and the restrictions of pupils' achievement levels were characterized dependent on the MDPT attributes (i.e., unsatisfactory, satisfactory, basic ,or advanced).

As characterized in the MDPT attributes, the advanced degree of achievement requires the pupils to aggregate 26–33 standard points from their MDPT tasks done during the examination; the basic level requires 16–25 standard points, the satisfactory level 7–15 standard points, while the inadmissible level requires 0–6 standard points. These levels are portrayed by the pupils' fundamental action capacity groups: mathematical information and aptitudes of performing standard methods, mathematical communication, mathematical reasoning, and critical thinking. In light of these pupils' achievement levels, the proficiency of the pupils' learning association measure is surveyed. The degree of student achievement is a measure of the assessment of the association of the learning cycle. This assessment is utilized in the examination, translation, and correlation of the association between student learning association strategies and achievement.

2.3. Procedure

In this study, a pre-test/middle-test/post-test experimental strategy was used to avoid any disruption of educational activities due to the random selection of children in each group. The study consisted of two groups (i.e., experimental and control) that were the same in terms of the characteristics observed. The subject of mathematics is being taught/learned according to the Primary Education General Curriculum (2016) and by using the mathematics textbooks that meet the requirements for textbook development approved and recognized by the Ministry of Education, they are thus suitable for use in mathematics lessons.

The experimental group was tested for eight months. The experimental group was subjected to systematic integration of the learning/digital assessment platform EDUKA into the mathematics lessons, while the control group had traditional mathematics lessons without the use of the learning/digital assessment platform EDUKA. The subjects learned in their usual classroom environment with their class teacher (Table 1).

It should be noted that the learning/digital assessment platform EDUKA includes all sets of mathematics gradebooks for primary education including 1st grade mathematic textbooks. Every teacher was able to make an individual decision regarding the use of the tools available from the virtual teaching/learning platform in their teaching, combining the presently taught mathematics topic with the exercises available at the EDUKA exercise bank. Thus, with the purpose of enriching the traditional way of teaching/learning a subject, every person receiving a primary education in the subject of mathematics theoretically has the opportunity to an enriched traditional teaching/learning environment and can use the virtual teaching/learning platform and the opportunities it provides (digital library, exercise bank, repository, etc.) [35].

In order to establish the effect of the learning/digital assessment platform EDUKA on the learning outcomes of the primary-grade students in the subject of mathematics, the experimental and control group mathematics lessons were interrupted, and mathematical testing was conducted in the beginning (pre-test), the middle (mid-test), and the end (post-test) of the school year.

Table 1. The course and organization of a mathematics lesson in the experimental and control groups.

The Course of a Mathemetics Lesson	
Experimental Group	**Control Group**
Introduction to the Lesson	
The teacher announces the topic of the lesson by presenting the problem question. Lesson objectives are set. Competencies developed are presented.	The teacher announces the topic of the lesson, which is indicated in the textbook. Lesson objectives are set. Competencies developed are presented.
The students actively participate in the lesson, listen to the teacher, ask follow-up questions and share experiences.	The students actively participate in the lesson, listen to the teacher, give follow-up questions, and share experiences.
The Main Part of the Lesson	
The teacher: (1) presents and explains the educational material given in the textbook, gives questions to the students, explains the rules, and presents the strategy for doing the exercises. (2) After logging into EDUKA, a topic-specific educational video is played. It illustrates the practical application of the strategy for doing the exercises. (3) The strategies for doing the topic-specific exercises are explained. (4) Practical tasks are assigned, the students' learning process is observed and they are consulted.	The teacher: (1) presents and explains the educational material given in the textbook, gives questions to the students, explains the rules, and presents the strategy for doing the exercises. (2) Practical tasks are assigned, the students' learning process is observed and they are consulted.
The students (1) Observe the presentation of the lesson, listen to the teacher's explanation and answer/ask questions. (2) Watch the topic-specific educational video available at EDUKA, are introduced to the practical application of the strategy for doing the exercises. (3) Clarify (by asking/answering questions) the strategies for doing topic-specific exercises. (4) Consolidate the new knowledge on the subject by doing the assigned tasks: (4.1) Independently do the exercises available at EDUKA and immediately receive feedback on them. (4.2) Do the exercises from the textbook together with their friend/class. (4.3) Independently do the exercises from the workbook.	The students (1) Observe the presentation of the lesson, listen to the teacher's explanation and answer/ask questions. (2) Clarify (by asking/answering questions) the algorithms for doing topic-specific exercises. (3) Consolidate the new knowledge on the subject by doing the assigned tasks: (3.1) Do the exercises from the textbook together with their friend/class. (3.2) Independently do the exercises from the workbook.
The Final Part of the Lesson	
The teacher summarizes the lesson.	The teacher summarizes the lesson.
The students self-evaluate their success on reaching the set objectives.	The students self-evaluate their success on reaching the set objectives.

2.4. Data Analysis

Descriptive statistics were reported for all measured variables as a mean ± SD. The effect size of the Mann–Whitney U test was calculated using the equation $r = Z/\sqrt{N}$, in which Z is the z-score and N is the total number of the sample (small: 0.1; medium: 0.3; large: 0.5). Statistical significance was defined as $p \leq 0.05$ for all analyses. Analyses were conducted using SPSS 23 software (SPSS Inc., Chicago, IL, USA).

3. Results

3.1. Mathematics Diagnostic Progress Tests

An examination of the consequences of the pre-test of the MDPTs shows that, across the seven potential MDPT's tasks, the male and female seven-year-old children accomplished satisfactory outcomes (pre-test: control gathering (CG) 6.06; test gathering (EG) 6.01; p = 0.705) and basic outcomes (pre-test: CG 5.12; EG 5.2; p = 0.071). Less children qualified for the advanced level (pre-test: CG 1.45; EG 1.55; p = 0.102) (Figure 1). The outcomes were assessed among experimental (EG) and control (CG) groups.

The investigation of the middle test outcomes (results were seen between groups) at all number of children performing at an advanced level (middle test: CG 1.35; EG 1.47; p = 0.048). Most children who finished the tests performed to basic and satisfactory levels. In like manner, CG's and EG's achievements levels were satisfactory (middle test: CG 4.36; EG 4.68; p = 0.045) and basic (CG 4.89; EG 5.02; p = 0.048). The contrasts between the pre-test and middle test outcomes demonstrated that the number of children performing at a satisfactory level diminished (p = 0.031) (Figure 1).

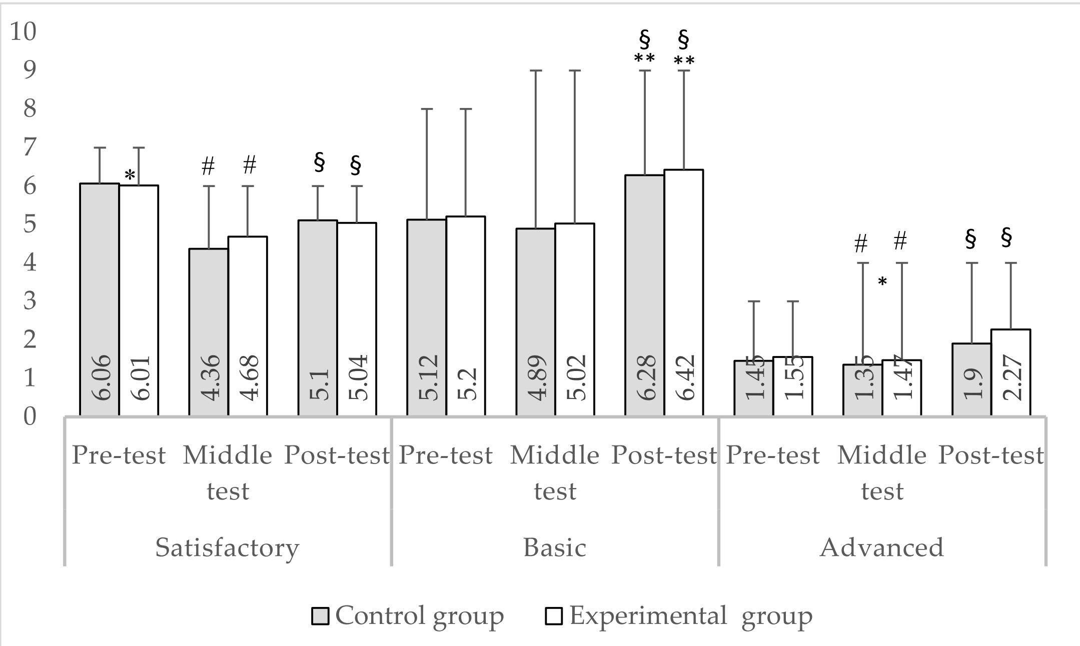

Figure 1. Mathematics diagnostic progress tests. * $p \leq 0.05$, the difference between the control and the experimental groups; # $p \leq 0.05$, differences between the pre-test and middle-test; § $p \leq 0.05$, differences between the middle- and post-test; ** $p \leq 0.05$, the differences between the pre-test and post-test.

An analysis of the results of the MDPT's showed that, across the seven possible tasks, both male and female seven-year-old children achieved satisfactory results (results were observed between groups) (post-test: CG 5.10; EG 5.04; p = 0.560), basic results (post-test: CG 6.28; EG 6.42; p = 0.630) and advanced results (post-test: CG 1.90; EG 2.27; p = 0.025). The differences between the pre-test and post-test advanced (p = 0.038) and the pre-test and post-test basic (p = 0.018) levels were found to increase (Figure 1).

3.2. Cognitive Ability

Table 2 presents the dynamics of the distribution of students in the CG and EG groups in all three tests by areas of cognitive ability. Analyzing the distribution of primary-grade students by areas of cognitive ability, in pre-test, statistically significant change was observed only in the area of higher thinking skills (p = 0.025); in the middle-test, statistically significance was evident in the areas of knowledge and understanding (p = 0.038) and application (p = 0.048); in post-test, statistically significant change was found in the areas of knowledge and understanding (p = 0.034), as well as higher thinking skills (p = 0.015).

Table 2. Dynamic of primary-grade students' distribution by areas of cognitive ability.

Test	Control Group	Experimental Group	p-Value	Observed Power	Effect Size
Pre-Test					
Knowledge and understanding	5.06 (0.94)	4.96 (1.04)	0.157	0.278	-
Application	5.62 (2.38)	5.57 (2.43)	0.051	0.691	-
Higher thinking skills	**1.74 (2.26)**	**2.14 (1.86)**	0.025	0.991	**0.50**
Middle-Test					
Knowledge and understanding	**3.99 (2.01)**	**4.26 (1.74)**	0.038	0.926	**0.19**
Application	**4.46 (1.54)**	**5.13 (0.87)**	0.048	0.967	**0.11**
Higher thinking skills	1.85 (3.15)	1.99 (3.01)	0.459	0.188	-
Post-Test					
Knowledge and understanding	**4.15 (1.85)**	**4.73 (1.27)**	0.034	0.975	**0.31**
Application	5.75 (2.25)	6.04 (1.96)	0.498	0.152	-
Higher thinking skills	**3.00 (2.00)**	**4.04 (0.96)**	0.015	1.00	**0.66**

Cognitive ability: significant values are highlighted in bold. Effect size for nonparametric test: r (small: 0.1; medium: 0.3; large: 0.5) for group differences.

3.3. Distribution of Mathematical Learning Achievements According to Curriculum Content

Table 3 presents the results of the descriptive data of participants by learning achievements with respect to curriculum which yielded the following results. Numbers and calculations: pre-test CG and EG (p = 0.159), middle-test: CG and EG (p = 0.120), and post-test CG and EG (p = 0.046). Phenomena, equations, and inequalities: pre-test CG and EG (p = 0.049), middle-test: CG and EG (p = 0.028), and post-test CG and EG (p = 0.026). Geometry, measures and measurements: pre-test CG and EG (p = 0.067), middle test CG and EG (p = 0.025), and post-test CG and EG (p = 0.031). Statistics: pre-test CG and EG (p = 0.029), middle-test: CG and EG (p = 0.042), and post-test CG and EG (p = 0.021). Communication and general problem-solving skills: pre-test CG and EG (p = 0.082), middle-test CG and EG (p = 0.019), and post-test CG and EG (p = 0.036) (Table 3).

Table 3. Distribution of mathematical learning achievements according to curriculum content.

Test	Control Group	Experimental Group	p-Value	Observed Power	Effect Size
Pre-Test					
Numbers and calculations	6.81 (2.19)	6.71 (2.29)	0.159	0.231	-
Phenomena, equations, inequalities	**0.64 (0.36)**	**0.71 (0.29)**	0.049	0.963	**0.13**
Geometry, measures, and measurements	3.31 (0.69)	3.24 (0.76)	0.067	0.586	-
Statistics	**0.26 (0.74)**	**0.18 (0.82)**	0.029	0.989	**0.18**
Communication and general problem-solving skills	1.30 (1.70)	1.34 (1.66)	0.082	0.551	-
Middle-Test					
Numbers and calculations	5.29 (3.71)	5.43 (3.57)	0.120	0.238	-
Phenomena, equations, inequalities	**0.83 (1.17)**	**1.10 (0.90)**	0.028	0.990	**0.27**
Geometry, measures, and measurements	**2.42 (1.58)**	**2.85 (1.15)**	0.025	0.975	**0.31**
Statistics	**0.96 (1.04)**	**1.12 (0.88)**	0.042	0.926	**0.19**
Communication and general problem-solving skills	**0.75 (1.25)**	**1.30 (0.70)**	0.019	1.00	**0.66**

	Post-Test				
Numbers and calculations	**6.13 (1.87)**	**6.80 (1.20)**	0.046	0.966	**0.48**
Phenomena, equations, inequalities	**1.52 (0.48)**	**1.82 (0.18)**	0.026	0.981	**0.28**
Geometry, measures, and measurements	**4.16 (1.84)**	**4.89 (1.11)**	0.031	0.974	**0.38**
Statistics	**0.45 (0.55)**	**0.69 (0.31)**	0.021	0.977	**0.12**
Communication and general problem-solving skills	**0.72 (1.28)**	**1.00 (1.00)**	0.036	0.926	**0.19**

Mathematical learning achievements: significant values are highlighted in bold. Effect size for nonparametric test: *r* (small: 0.1; medium: 0.3; large: 0.5) for group differences.

4. Discussion

The main aim of this study was to establish the effect of the learning/digital assessment platform EDUKA on the learning outcomes of primary-grade students in the subject of mathematics. This study provides some of the strongest evidence to date on the relationship between specific virtual learning dimensions and primary school children mathematics achievements. The results suggest that the use of digital learning platform EDUKA was not limited to enhancing knowledge and understanding through better memorization, but also increased motivation and activated the learning process itself. This complements the findings of other researchers that digital learning is adaptive and engaging [10–12], increases the learning time for learners, and enhances their learning performance [20]. The use of attractive and advanced teaching/learning tools encourages pupils to create their own activities of discovery that stimulate diverse thinking and problem representations, all of which help generate intrinsic motivation [14-16] for pupils to learn. More active pupil involvement may also lead to better subject learning outcomes (in the case of this study, mathematics). The results of this study suggest that EDUKA, which has been designed prioritizing the pedagogical and constructivist approaches to learning, allows the learner to be present and "pedagogically immersed" in each learning stages: they experience some degree of immersion into the primary representation of the concept, immersion in the task, immersion in the interaction or discussion with others, and experience that meets the intended learning outcomes [19].

Research conducted by Blazar [11], Garcia, and Pacheco [12], as well as Kim and Ke [36], indicate that virtual environments intended to optimize and maintain the teaching/learning process are modern, flexible, and attractive to students. The virtual environment offers a wide spectrum of measures and tools to maintain and enrich traditional teaching/learning according to the students' individual needs and abilities. These measures not only motivate the students and activate learning but also help the teacher to be creative while planning teaching lessons [11,12,36]. Virtual learning is considered an important part of the future teaching model. Digital learning is considered the "new normal" for future teaching and learning solutions. Digital learning combines education technology solutions, teaching and learning strategies, and new scenarios of educational practice, creating an agile model tailored to the needs of education. The pursuit of quality and efficiency in virtual learning requires a major overhaul of teaching and learning solutions [37]. A student-centered teaching and learning process with the primary goal of promoting student development, encouraging and directing teachers to select appropriate digital education resources according to the nature of the subject and students' development needs, appropriately intervene and regulate the student's learning, and meaningfully build up and use learning activities to lead students to learn independently. These are crucial aspects to cultivate when undertaking virtual learning [37]. Chappell et al. found support regarding online mathematics learning and provides further testimony that the strategy can be fruitful for improving mathematics achievements of underperforming middle school students [38].

Taujanskiene et al. [39] found similar results when they used a quasi-experiment to assess students' progress in mathematics. It was conducted under conditions natural for children. They worked with their class teacher in their classroom as during other classes. It was found that the learning/digital assessment platform EDUKA intensively integrated into formal education and into mathematics had a significant impact on students' achievement in mathematics [33]. Kondrataviciene [27] revealed the peculiarities of differentiation and individualization of curriculum in a classroom compared to the virtual learning environment. The results of the study showed that in the learning/digital assessment platform EDUKA, the teacher quickly and easily divides students into homogeneous groups according to their progress, ability, and interests. Based on the individual differences between the students, the teacher creates open-ended tasks and closed-ended tests, as well as additionally employing teaching and learning materials (files/links) created during the educational process. EDUKA enhances teachers' work by helping them to differentiate learning content, monitor student progress, and assess learning outcomes. Moreover, it also enables/allows teachers to provide feedback and feedforward to students and their parents [27]. Larkin [40] states that virtual teaching/learning platforms are, at the same time, potential teaching/learning platforms—when virtual learning is taking place, information is exchanged among the learners, and they are able to learn through communicating and cooperating. This suggests that the virtual environment promotes social interaction, which allows one to not only search for information but also to exchange it, expanding the knowledge of the learners and shape understanding [34].

We made the assumption that our study revealed that the results of the intervention of the virtual learning platform EDUKA into traditional mathematics lessons was effective, had positive and significant effect on pupils mathematical literacy skills construction.

5. Conclusions

It was found that intensively integrating the learning/digital assessment platform EDUKA into formal education—specifically in the subject of mathematics—had a significant impact on primary school children's mathematical performance. After the experiment, the difference between the pre-test and post-test results of primary school children with a satisfactory level decreased significantly statistically ($p < 0.05$). In addition, after the experiment, a statistically significant difference was found ($p < 0.05$) in primary school children with higher levels. The study revealed that the experimental group demonstrated higher scores in the Application and Higher thinking skills area at the end of the study. Pupils' higher cognitive skills of thinking and application have significantly developed in comparison to the research group, which did not apply the virtual learning/assessment platform EDUKA during mathematics education. The intervention in the experimental group (i.e., the integration of the virtual learning platform into the formal mathematics learning process) had a positive impact on access to mathematics. Students' math learning achievements were positive in progressive mathematics. Demonstrating higher achievements in mathematics among students by the field of content and activity, significant advances in the cognitive abilities of the students' thinking and application were evident in the experimental group with the virtual learning platform in the process of mathematics education, but these did not apply to that of the control group.

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