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The Effect of A Number Sense Education Program Supported By Web 2.0 Tools on The Number Sense Development of First Grade Elementary School Students*

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Abstract

This research was designed to evaluate the effectiveness of a Number Sense Education Program enhanced by Web 2.0 Tools on the development of number sense among first-grade elementary students. The study's cohort comprised 44 children, divided into an experimental group of 23 and a control group of 21. Employing a quasi-experimental design from quantitative research methodologies, data was collected using the "Number Sense Screener (NSS)"—originally developed by Jordan et al. (2012) and later adapted for Turkish first-grade students by Uyanık Aktulun (2019) alongside a "General Information Form" to collect personal data from families. Over the course of 12 weeks, the experimental group participated in the Web 2.0 Tools-supported Number Sense Education Program, conducted by the researcher, while the control group engaged in regular curriculum lessons. The findings revealed statistically significant improvements in the experimental group's pre-test and post-test scores across several NSS subdimensions, including Number Recognition, Number Comparisons, Nonverbal Calculation, Story Problems, and Number Combinations, as well as in their overall NSS scores ($p<.05$). However, no significant change was detected in the Counting Skills subdimension ($p>.05$). Furthermore, a statistically significant difference emerged between the experimental and control groups' post-test average scores in the NSS subdimensions and overall score ($p<.05$), underscoring the beneficial impact of Web 2.0 Tools-supported educational processes on enhancing number sense skills.

Keywords: Elementary school, mathematics, number sense, number sense skills, web 2.0 tools

* This article is a part of the master's thesis titled " The Effect of A Number Sense Education Program Supported By Web 2.0 Tools on The Number Sense Development of First Grade Elementary School Students " prepared by the first author under the supervision of the second author.

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Introduction

In recent years, technological advancements have facilitated the integration of digital tools into all areas of life, including educational processes (Aytan & Başal, 2015). This rapidly popularizing situation has led to the formation of contemporary educational processes (Alkan, 2011). Considering that 83% of learning experiences are visual, 11% are auditory, 3.5% are olfactory, 1.5% are tactile, and 1% are gustatory, educational and instructional technologies offer quality learning opportunities with visualization, sound addition, and interactive touch features. This situation enables students to be involved in more quality educational processes, thereby supporting the development of their higher-order cognitive skills (Çalışkan & Karadağ, 2013; Sarsar, 2017).

In the process of integrating advancing technologies into education, the use of Web 2.0 tools, in particular, has become very widespread (Çakır et al., 2019). Web 2.0 technologies facilitate the transition from being merely internet readers to becoming internet literates. This shift has transformed the internet from a space where pre-existing information is consumed into a platform where participants are involved in the production and sharing of information, gathering and transferring knowledge (Horzum, 2010). According to Çelebi and Satırlı (2021), Web 2.0 tools assist in making learning both effective and enjoyable for students, positively affect their level of technological literacy, and increase their motivation. At the same time, these tools provide teachers with opportunities that simplify teaching, such as lesson planning, implementing activities, enrichment, recording, and evaluation.

Web 2.0 tools are user-friendly programs known for their ease of use. Literature reviews indicate that researchers have classified Web 2.0 tools under specific headings based on the functionality of the tools used and their suitability for the educational environment, making them easily accessible to teachers or those interested in Web 2.0 Tools (Elmas & Geban, 2012). Some of these classifications include: Çopur (2020) categorized Web 2.0 tools used in education under various headings: For classroom management; Edmodo, Voki, ClassDojo. For quizzes and exams; Kahoot, Quizlet, Quibblo. For online gaming and content creation; LearningApps.org, Goconqr, Oppi. For presentation creation; Prezi, Emaze, Powtoon. For mapping and concept mapping; Mindmeister, Datawrapper, Bubbl.us. For animation or cartoon creation; Moovly, Vyond, Animoto. For coding education; Scratch Mit Edu, Code.org, Tynker. For online learning platforms; EBA, Khan Academy, Udemy. For augmented reality; Metaverse, QuiverVision, Cospaces. For teaching foreign languages; Duolingo, Lyricstraining, Voscreen Çelebi and Satırlı (2021) in their study on the use of Web 2.0 tools at the elementary level, included 38 Web 2.0 tools categorized into 15 categories. These categories are listed as follows: Survey tools; Surveymonkey, Kahoot, Google Form. Animation tools; FlipaClip, Animaker. Photo and image tools; Camera360, Canva. Virtual wall board tools; Padlet, Twinspace. Online quiz and exam tools; Quickkey, Exam Reader, Quizlet, Plickers, Quizizz. Remote management tools; Zoom, Microsoft Teams. Classroom management tools; Voki, Google Classroom, Class Dojo. 3D tools: Unity 3D, Anatomy 3D-Anatronica. Math tools; Matific. e-book creation tools; Bookcreator, Joomag, My Storybook. Web page creation tools; Blogger, Weebly, WordPress. Coding tools; Code.Org, Kodable. Story writing tools; BookPress, Storybird, StoryJumper. Video and music creation tools; Kizoa, iMovie, Animoto. Slide and presentation tools; Prezi, Powtoon, Emaze.

These classifications highlight the diversity and potential of Web 2.0 tools in education, providing guidance for teachers and educators on how to integrate these tools into their lesson plans. Web 2.0 tools such as Voki, LearningApps.org, Wordwall, and Storybird, which are among the most used in educational processes, offer features that enrich learning processes, making learning more interactive and enjoyable. For instance, Voki is a Web 2.0 tool that allows for the creation of various characters and enables these characters to speak with written texts. This application allows users to select a character from an online environment, type a text into a textbox to vocalize the character, and ultimately generate a link for sharing with students independently of time and location (İnal & Arslanbaş, 2021). LearningApps.org is a Web 2.0 tool that offers the possibility to create educational games and activities with interactive elements to support the teaching and learning process. It allows for the creation of new online elements as well as the reorganization of existing ones. The goal is to compile reusable elements and make them available to the public. Referred to as applications, these

elements do not have a fixed framework or a concrete mold, yet they interact within the digital environment. The content of these elements is not finalized; instead, they can be integrated by users into different classroom environments (LearningApps, 2012). Wordwall is a Web 2.0 tool that provides the ability to create interactive tests of various types, such as multiple-choice, matching, true or false, drag and drop, offering students the pleasure of game-playing rather than just learning outcomes. This online assessment tool encourages students to engage in the process and enjoy their lessons, while also providing teachers with the opportunity to design exercises, activities, and games. The application, with an interface in English, offers users the choice of 26 languages and access through Google or Gmail personal accounts. Wordwall, with its rich content, is available for use across different subjects and levels (İnal & Arslanbaş, 2021). Templates in Wordwall are available in both interactive and printable versions. Interactive activities can be played on computers, tablets, phones, or interactive whiteboards, while content that can be downloaded as PDFs can be directly printed. Activities are created using a template system, which includes examples like Quiz, Crossword, Maze Chase, Airplane, and Seating Plan. Existing activities can be customized to suit one's class and teaching style. Themes within the app can be presented with different themes, with each theme allowing the addition of different graphics, fonts, and sounds. Wordwall activities can be embedded into another website using an HTML code, functioning similarly to embedding playable videos from YouTube or Vimeo, offering an embed feature that allows users to play activities directly on their own sites (Wordwall, 2023). The diversity offered by these Web 2.0 tools facilitates the adoption of innovative approaches in teaching methodologies while enabling students to interact with materials that are suitable for their individual learning styles.

The integration of technology into educational processes has brought significant changes to access to information, communication, and action, particularly manifesting in the field of mathematics education (Karaaslan et al., 2013). The development of Web 2.0 tools and the understanding, monitoring, and effective use of these tools in mathematics education have led to significant differentiations in learning and teaching processes (Ersoy, 2003). As a universal language and culture, mathematics, one of the oldest branches of science, enables individuals to acquire mathematical concepts and skills through concrete experiences in their daily lives. These experiences play a critical role in laying the foundations of mathematical thinking. Mathematical thinking is the ability to analyze information, use it, and freely generate and evaluate ideas. Acquiring these fundamental skills lays the groundwork for the mathematics knowledge and concepts necessary for school life, positively reflecting on children's subsequent learning processes, enhancing their success, and contributing to becoming more productive and efficient individuals (Kandır et al., 2016). In this context, the inclusion of technology, especially Web 2.0 tools, in mathematics education emerges as a significant factor in developing mathematical thinking skills and deepening the learning of mathematics.

Mathematics, as a discipline that is influenced by technological advancements and continuously evolving, encompasses a diverse range of topics (Dennis & Hamm, 2010). In this context, the National Council of Teachers of Mathematics (NCTM) emphasizes that number sense is particularly important for 21st-century mathematics education (Şengül, 2013). Number sense is critically important for understanding numbers, making comparisons between numbers, establishing relationships, and developing advanced mathematical skills (Berch, 2005). Definitions of the concept of number sense by scientists from various disciplines generally include the ability to identify and count numbers, understand relationships between numbers, make magnitude comparisons, perform basic numerical operations, comprehend estimation and measurement concepts, determine and complete a missing number as key components of this concept (Kalchman et al., 2001; Lago & DiPerna, 2010). The skills expressed in these definitions enable the use of mathematical knowledge and the rapid execution of mathematical operations (Gersten & Chard, 1999). The study conducted by Jordan and colleagues (2006) identifies the essential elements of number sense in preschool and early elementary children as counting, number knowledge, number transformation, estimation, and Number Combinations / Number Patterns. These components represent children's relationships with numbers and their capacity to understand mathematical operations. Counting is related to children's grasp of number sequences and their ability to accurately count objects in various quantities, where understanding the basic principles of counting such as one-to-one correspondence, stable order, and cardinality is fundamental (Jordan et al., 2006; Jordan et al., 2007). Number knowledge encompasses the ability to recognize

numbers and directly identify small quantities (Jordan et al., 2007), while number transformation refers to the skill of transitioning between numerical sets through addition and subtraction operations. Estimation ability allows children to approximately assess the magnitude of numerical sets, and Number Combinations / Number Patterns enable them to understand the intricate structure of numbers and how a number can be associated with different numbers. These five fundamental components are critically important for developing children's mathematical thinking and problem-solving skills, enabling them to apply their knowledge to new and unknown situations to find solutions. As children gain experience, they develop the ability to perform mathematical operations more quickly and efficiently (Confer, 2005).

Research across various disciplines on the effects of number sense development underscores the importance of number sense in mathematics instruction and suggests it plays a central role in elementary mathematics teaching by enabling students to connect with real life (Yang et al., 2004). However, it has been observed that the Primary School Mathematics Curriculum in Turkey (2018) does not directly refer to number sense. In this context, Gülbağcı Dede (2015) analyzed the compatibility of the Elementary Mathematics Teaching Program (2009) with number sense and stated that 21 outcomes for the first grade are related to number sense. Şengül (2013), by examining the Primary School Mathematics Teaching Program (2009) without breaking it down into components in terms of number sense, identified that two outcomes in the first grade are related to number sense. Çetin and Öztürk (2020) have identified in the Primary School Mathematics Curriculum (2018) a total of five outcomes related to the learning area of numbers and operations for the 1st-grade level, including one on the meaning of numbers, one on the magnitude of numbers, two on flexible operation and judging the plausibility of results, and one in the learning area of measurement related to the component of estimation. Considering that individuals acquire a significant portion of the mathematical skills they will use throughout their lives from the outcomes included in the mathematics teaching program, and given the contemporary expectation for individuals to utilize high-level numerical skills, the importance of more prominently incorporating number sense in the Mathematics Teaching Program becomes evident. Focusing more on number sense outcomes in Mathematics Teaching Programs has been shown to enable students to achieve better mathematics success in subsequent stages and offer significant opportunities in shaping students' learning regarding number sense (Cheng & Wang, 2012). Research in this area, including studies by Starr et. al., (2017), has found that number sense acquired during infancy predicts mathematics learning in early childhood. Jordan and colleagues (2009) emphasize the importance of early number competence or number sense in predicting children's success in mathematics learning throughout elementary school. Şengül and Gülbağcı Dede (2014) have stated that number sense prepares students for generating different solutions to numerical situations encountered in daily life by directing them to think flexibly and produce various strategies without relying solely on standard algorithms and pen-and-paper calculations. Yarar et al., (2018) have indicated that students with a developed sense of number can successfully overcome problems encountered in daily life, perform quick mental calculations, and reach conclusions through estimation, suggesting that students' overall success in learning is related to their sense of number. This concept plays a crucial role not only in performing numerical operations but also in developing flexible and varied solutions to problems encountered in daily life (Küçükay, 2022). Therefore, the development of number sense is among the fundamental skills for the development of an individual's mathematical abilities and success in mathematics at advanced educational levels, and this development should be supported from the early years of life.

Success in the field of mathematics plays a fundamental role in the development of science, technology, and industry, emerging as a significant factor in enhancing individuals' problem-solving and higher-order thinking skills (Thornton et al., 2009). However, when considering Turkey's perspective, international assessments like TIMSS (2019) and PISA (2018) reveal that students in Turkey perform poorly in mathematics. The results of YKS (2022) and LGS (2022) also indicate that students have weak averages in mathematics, highlighting the need for a fundamental strengthening of mathematics education. Quality mathematics instruction in early education helps children acquire mathematical concepts and skills they will use throughout their life (Seefeldt & Galper, 2004; Jackman, 2012; Henniger, 2012). Therefore, developing technology-supported quality education programs that enhance number sense skills for students attending the first grade of primary school,

which is the starting point for other grades, is crucial. When a literature review is conducted, it is observed that studies related to Web 2.0 tools, which have become a current educational tool with the development of technology and the influence of the remote education process, and number sense have been conducted. In the field literature related to the subject; Bayak (2016) examined the number sense levels of classroom teachers and their usage in elementary school mathematics teaching; Çetin & Öztürk (2020) analyzed the effect of the elementary mathematics curriculum on the fundamental components of number sense; Yapıcı (2013) explored the number sense of 5th, 6th, and 7th-grade students in the topic of percentages; Çekirdekçi, Şengül & Doğan (2020) studied the number sense strategies used by 4th-grade students; Gözüm et al. (2024) investigated how number sense skills develop from preschool education to the transition to elementary school; Zhou et al. (2022) researched the mediating effect of number sense on non-verbal intelligence and children's mathematical performance; Tucker and Johnson (2022) evaluated the impact of a touchscreen digital game named Fingu on the development of preschool children's number sense; Tonizzi et al. (2021) compared the effects of two different intervention programs with low and high intensity on developing number sense in children from low socio-economic status; Gillespie (2021) studied the impact of a mathematical activity called "Number Talks" developed for elementary students on the development of their number sense and mathematical discourse skills. However, there have been no studies found in the field literature that examine the effect of a Number Sense Education Program Supported by Web 2.0 Tools on the development of number sense in first-grade elementary students. Therefore, this research is thought to contribute by revealing the effect of the Number Sense Education Program Supported by Web 2.0 Tools on the development of number sense, enhancing the quality of mathematics teaching, serving as a guide for teachers and parents towards formal and informal experiences, offering a new perspective on the concept of number sense, and attempting to fill a significant gap in the field literature. The primary objective of this study is to examine the effect of a Number Sense Education Program Supported by Web 2.0 Tools on the development of number sense in first-grade elementary students. To this end, the following sub-problems have been explored:

Is there a statistically significant difference between the pre-test average scores of the experimental and control group students in the sub-dimensions and the total of the Number Sense Assessment Tool?

Is there a significant difference between the pre-test and post-test scores of the experimental group students in the sub-dimensions and the total of the Number Sense Assessment Tool?

Is there a meaningful difference between the pre-test and post-test scores of the control group students in the sub-dimensions and the total of the Number Sense Assessment Tool?

Is there a statistically significant difference between the post-test average scores of the experimental and control group students in the sub-dimensions and the total of the Number Sense Assessment Tool?

Is there a significant difference between the post-test and follow-up test scores of the experimental group students in the sub-dimensions and the total of the Number Sense Assessment Tool?

Method

Research Model

In the study, a pre-test, post-test, and follow-up test quasi-experimental design with control groups was used to test the effect of a Number Sense Education Program Supported by Web 2.0 Tools on the number sense development of first-grade elementary students. In this design, the dependent variable is "Number Sense Development," and the independent variable being examined for its effect on the number sense development of first-grade elementary students is the "Number Sense Education Program Supported by Web 2.0 Tools" (Büyüköztürk, 2014; Büyüköztürk et al., 2014). In this research, it was controlled that the pre-tests of the groups in terms of the dependent variable, number sense development, were similar.

In the study, the children in the experimental group were subjected to the Number Sense Education Program Supported by Web 2.0 Tools by the researcher, while the children in the control group were subjected to the mathematics activities in the Ministry of National Education (MEB, 2018) program, also implemented by the researcher.

Population and Sample

The universe of the study consists of first-grade children who attend schools under the Ministry of National Education in the İhsaniye district of Afyonkarahisar during the 2022-2023 academic year, who show normal development and have not previously been subjected to a special program related to numbers. In forming the sample, schools were initially identified. For this purpose, a list of elementary schools in the İhsaniye district of Afyonkarahisar province was obtained from the District National Education Directorate. From this list, schools with a first-grade student population not less than 20 were identified. For the sake of convenience in conducting the study, class 1-A of School A was selected as the experimental group, and class 1-B of the same school was selected as the control group. Necessary permissions were obtained from the Afyonkarahisar Provincial Directorate of National Education before the research commenced at this school. The study engaged a total of 44 students, with 23 in the experimental group and 21 in the control group. The demographic information of the students included in the sample is provided below in Table 1.

Table 1.

The Demographic Information of The Students Included In The Sample.

Demographic Variables	Experimental		Control	
Gender	*f*	*%*	*f*	*%*
Female	12	52.2	9	42.9
Male	11	47.8	12	57.1
Number of Children in the Family	*f*	*%*	*f*	*%*
Only child	2	8.7	-	-
2 children	7	30.4	11	52.4
3 children	11	47.9	6	28.6
4 children	2	8.7	3	14.3
4 or more children	1	4.3	1	4.8
Mothers Age	*f*	*%*	*f*	*%*
29 years and under	1	4.3	7	33.3
30-39 years	18	78.3	7	33.3
40-49 years	4	17.4	7	33.4
Fathers Age	*f*	*%*	*f*	*%*
29 years and under	-	-	1	4.8
30-39 years	11	47.8	12	57.1
40-49 years	12	52.2	8	38.1
Mother's Education	*f*	*%*	*f*	*%*
Primary and middle school	11	47.8	19	90.5
High school	9	39.1	2	9.5
University	2	8.7	-	-
Postgraduate	1	4.3	-	-
Father's Education	*f*	*%*	*f*	*%*
Primary and middle school	9	39.1	14	66.7
High school	10	43.5	6	28.6
University	3	13.0	1	4.8
Postgraduate	1	4.3	-	-

Upon examining Table 1, it was determined that in the experimental group, the majority of students are female (52.2%), 47.9% have 3 siblings, 78.3% of mothers are aged between 30-39, and 47.8% of mothers have completed primary or middle school education. Additionally, 52.2% of fathers are aged between 40-49, and 43.5% have a high school diploma.

In the control group, the majority of students are male (57.1%), 52.4% have 2 siblings, 33.4% of mothers are aged between 40-49, and 90.5% of mothers have completed primary or middle

school education. Moreover, 57.1% of fathers are aged between 30-39, and 66.7% have completed primary or middle school education.

Data Collection Tools

In the research, a "General Information Form" developed by the investigator was utilized to gather personal data about the students. Moreover, to evaluate the number sense abilities of first-grade elementary students, the Number Sense Screener—originally crafted by Jordan et al. (2012) and later adapted for Turkish children by Uyanık Aktulun (2019)—was employed.

General Information Form

The form was prepared by researchers to access information regarding the gender, number of siblings, age of the parents, their educational status, and professions of the students and their parents included in the research scope. For each child, the form was filled out based on the information available in the students' record files at the schools.

Number Sense Screener (NSS)

The Number Sense Screener is a condensed version of the research-based Number Sense Brief (33 items), developed for assessing the early numerical competencies of preschool and first-grade children (e.g., Jordan et al., 2006; Jordan et al., 2007). In this study, the Number Sense Screener consists of six subtests and a total of 29 items (Jordan et al., 2012). The administration time varies between 20-25 minutes for each child. Below are the details of the scale's sub-dimensions:

Counting Skills: This subtest, encompassing principles of counting (one-to-one correspondence, cardinality, and ordering) and rhythmic counting (counting rhythmically up to a given number), consists of a total of three items (Jordan et al., 2012)..
Number Recognition: This section requires children to name shown numbers (e.g., 13, 37). It consists of a total of four items (Jordan et al., 2012).

Number Comparisons: This subtest involves asking children to identify the number that comes after or two numbers after a given number (e.g., 7), and to determine which of the presented numbers (e.g., 5-4) is greater or smaller. Additionally, a series consisting of three numbers (6, 2, and 5) placed at three different points of an equilateral triangle is shown to the children. They are expected to find the number closest to the one at the top of the triangle (e.g., 5). This subtest comprises a total of seven items (Jordan et al., 2012).

Nonverbal Calculation: The items in this subtest are presented to the child using a white mat, a cardboard box, and ten black buttons of the same size included in the assessment tool. For example, for an addition operation, two buttons are placed on the mat within the child's view, and the child is told, "Do you see? There are two buttons here." After allowing the children to observe the buttons, they are covered with the lid of the box and placed inside the box. Then, another button is placed on the mat, and the child is told, "There is also one more button here," asking the child to watch carefully, and the button is similarly slid into the box with the lid. Subsequently, the page related to the item in the assessment tool is opened, and the child is asked to indicate the option that shows the total number of buttons inside the box. This subtest includes three addition and one subtraction operation, making a total of four items (Jordan et al., 2012).

Story Problems: In this subtest, children are told they may use their fingers, a number line (provided with the assessment tool), or paper and pencil to find the answers. Simple Story Problems are presented, such as, "Asya has m apples. Bilgehan gave her n more apples. How many apples does Asya have in total?" This subtest consists of five items, including three addition and two subtraction operations (Jordan et al., 2012).

Number Combinations: In this subtest, children are informed that they can use their fingers, a number line, or paper and pencil to find the answers if it helps. The Number Combinations dimension verbally presents questions like "What does two (2) plus (+) three (3) make?" and "What is left when three (3) is subtracted from five (5)?" This subtest contains four addition and two subtraction operations, comprising six items (Jordan et al., 2012).

Number Sense Education Program Supported By Web 2.0 Tools

In preparing the program content, in addition to literature analyses, outcomes and indicators aimed at supporting number sense skills were identified in collaboration with three field experts, based on the Mathematics Course Instruction Program (2018) for first-grade elementary by the Ministry of National Education. Before preparing lesson plans supported by Web 2.0 tools, the characteristics, needs, and levels of the students forming the experimental group were determined with the input of classroom teachers.

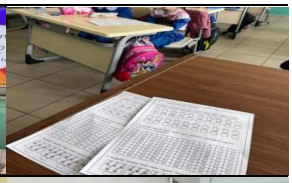
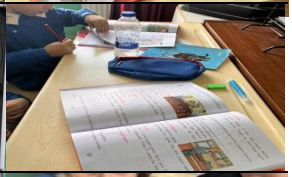
To ensure that the learning environment where students are educated is suitable for support with Web 2.0 tools, the characteristics of the learning and environmental setting were determined. In this context, the materials present in the classroom and the technological infrastructure were examined.

After conducting the necessary preliminary investigations and ensuring the suitability of the environmental conditions, an analysis of the unit outcomes in terms of number sense acquisition was carried out. During these analyses, all outcomes related to number sense were associated through joint decisions made by the researcher and the advisor. In the Ministry of National Education's first-grade mathematics curriculum, outcomes related to number sense are found within the "4 fundamental" subject areas and specifically in units "2, 3, 4, and 6." The learning processes, supported by suitable Web 2.0 tools and tailored to these specific subject areas and units, were then structured into a comprehensive 12-week program, reflecting both the recommended teaching durations and insights from expert opinions. This meticulous planning resulted in the creation of 11 detailed lesson plans, encompassing a total of 60 lesson hours, dedicated to advancing students' number sense through the innovative application of Web 2.0 tools. The lesson plans were meticulously crafted to seamlessly incorporate Web 2.0 tools, detailing aspects like lesson duration, objectives, methodologies, techniques, strategies, and assessing student readiness. They unfold in three structured phases: the introduction (engaging attention, stimulating prior knowledge, motivation, and clarifying objectives), the development phase (encompassing activities, interim recaps, and transitions), and the conclusion (final recap, reinvigoration, closure, and evaluation). The content and activities, devised with Web 2.0 tools, aim to foster students' number sense skills, ensuring they are developmentally suitable and centered around the learner. These plans are designed for an in-depth, systematic exploration of number sense dimensions, embracing a playful learning approach. The objective is for students to find joy in engaging with Web 2.0 tool-based activities, simultaneously attaining specified learning outcomes and developmental milestones.

The activities, engineered with Web 2.0 tools, are methodically organized from the simplest to the most complex tasks, promoting exploratory learning both independently and under adult guidance. Each task is broken down into phases, with numerous exercises contributing to the achievement of targeted outcomes and developmental benchmarks.

Every lesson plan is bolstered by educational tools from the Web 2.0 suite. For every activity, a minimum of three applications designed with Web 2.0 Tools have been integrated, arranged in order of increasing complexity. These applications are developed using freely accessible online platforms, including Wordwall, LearningApps, Storybird, Canva, Derslig, Okulistik, Voki, Math Kids, ABCYa, EBA, Primary Games, Pixton, and Arcademic Basics. The activities, curated or specifically created by researchers to be freely available, are thoughtfully chosen or devised to align with the lesson plans' intended outcomes, systematically presented to students to gradually escalate from straightforward to more demanding tasks. The lesson plans underwent a rigorous evaluation process by three experts specializing in number sense and classroom education. These experts were asked to assess the educational program and its various elements, including learning outcomes and indicators, conceptual understanding, the content of Web 2.0 tool-based activities, the alignment of the program's objectives with educational goals, the effectiveness of the learning methodologies employed, the relevance and sufficiency of the Web 2.0 tool-enhanced activities, the organization of outcomes and indicators, and the precision of the provided instructions. Based on the insights garnered from the expert evaluations, it was determined that certain Web 2.0 tool-incorporated activities necessitated additional refinement. Consequently, modifications were made to better align with the learning outcomes, leading to a more encompassing restructuring of the program.

Table 2.
Web 2.0 Tools and Associated Visuals Applied During the Experimental Study

Duration		Web 2.0	Images	
Week (W)	Hour (H)	Applied Web 2.0 Tool	ExperimentalGroup	Control Group
1W	5H	Digital Story (1 work) Wordwall (3 works) Derslig (34 works)		
2W	4H	Canva (Comic Book) (1 work) LearningApps (3 works) Okulistik (14 works)		
2.-3W	2H	Voki (Virtual Character in Narrative)(1 work) Derslig (10 works)		
3.-4W	5H	Fairy Tale (1 work) Okulistik (29 works) Math Kids (1 work)		
4-5W	7H	ABCYa (2 works) EBA (1 work) Primary Games (2 works)		
5-6W	5H	Wordwall (6 works) LearningApps (1 work)		
6.-7W	10H	Voki (1 work) LeraningApps (3 works)		
8W	5 H	Pixton (Concept cartoons) (1 work) ABCYa (2 works) Arcademic Basics (2 works)		
9W	5 H	Okulistik (12 works) Wordwall (4 works)		
10-11W	10 H	Voki (1 work) LearningApps (2 works) ABCYa (2 works)		
12W	4 H	Canva (1 work) Wordwall (1 work)		

Subsequently, with the objective of conducting a pilot study, the program was implemented according to a two-week planned schedule. This preliminary phase was successfully assessed in terms of time management, the appropriateness of activities to the students' levels, and their attitudes towards the lessons, all yielding positive outcomes.

Throughout the experimental study, activities prepared using Web 2.0 tools and applied each week are presented in Table 2.

As shown in Table 2, lesson plans and the content prepared with associated Web 2.0 tools have been designed and sequenced in a spiral manner, progressing from simple to complex. There are a total of 11 lesson plans and contents prepared using 13 different Web 2.0 tools. Emphasis has been placed on ensuring that activities created with Web 2.0 tools have the flexibility to be altered according to the students' interests, and they exhibit certain differences from conventional daily practices. Additionally, it was crucial that the activities were engaging, designed to entertain children while simultaneously facilitating their learning.

Data Collection Procedures

To assess the number sense skills of first-grade students in both the experimental and control groups, the Number Sense Screener was administered by the researcher as a pre-test between October 24, 2022, and January 20, 2023. The administration of the Number Sense Screener followed the specifications stated in its validity and reliability studies, such as conducting the test in a quiet and calm environment on a one-on-one basis with each child. Before the application, parents were informed about the content of the education program, and it was emphasized how crucial it was for students not to miss school, especially on the specified days and times. Subsequently, the Number Sense Education Program Supported by Web 2.0 Tools was implemented in the math classes of the experimental group by the researcher during the same dates, from October 24, 2022, to January 20, 2023. The education program sessions were conducted five days a week for 12 weeks, with each session lasting approximately 40 minutes. During this period, the math classes for the control group were also conducted by the researcher following the Ministry of National Education's First Grade Mathematics Curriculum. This approach eliminated any instructor (teacher-researcher) differences between the experimental and control groups.

While executing the Number Sense Education Program Enhanced by Web 2.0 Tools, meticulous preparation of the learning environment was undertaken before each session. This preparation involved setting up essential materials and technological resources, such as smart boards and computers, to facilitate the utilization of Web 2.0 tools. The scheduling of the educational program was established in collaboration with the teaching staff to ensure optimal timing. Efforts were made to secure the participation of all students in the classroom for the activities. The structure of each lesson was methodically organized into three segments: the introduction phase (engaging students' attention, activating prior knowledge, fostering motivation, and outlining the lesson's objectives), the development phase (conducting activities, providing interim summaries, and facilitating transitions), and the conclusion phase (delivering the final summary, reinvigorating motivation, concluding the session, and conducting assessments). Upon aligning the lessons with the Ministry of National Education's First Grade Mathematics Curriculum, students were then introduced to Web 2.0 tool-supported educational content designed to achieve specific learning outcomes. Students were assisted in engaging with and completing topic-related educational content using smart boards and computers. Activities developed with Web 2.0 tools were structured to accommodate both individual and small group participation. It is important to note that the educational content devised with Web 2.0 tools for the experimental group was exclusively used within this group and not introduced to the control group in any capacity. Prior to initiating the program, students in the control group were briefed on the upcoming 12-week mathematics curriculum, which would be directed by the researcher in accordance with the Ministry of National Education (2018) First Grade Mathematics Curriculum.

Subsequent to the implementation phase, the Number Sense Screener was administered as a post-test to both the experimental and control groups under the same environmental and procedural conditions

as the pre-test, spanning from October 24, 2022, to January 20, 2023. To evaluate the long-term impact and retention of the Web 2.0 Tools Supported Number Sense Program, the Number Sense Assessment Tool was employed four weeks post the administration of the post-tests. This retention test, conducted by the researcher, aimed to assess the program's enduring effects on all students from both groups during the same timeframe.

Data Analysis

The analysis began with the presentation of demographic details concerning both students and their parents, quantified through frequencies and percentages. The study deployed the Kolmogorov-Smirnoff (K-S) normality test on the scores derived from the Number Sense Screener, revealing a deviation from normal distribution, attributed to the participant count in each group being below 30. To discern differences across groups, the study utilized the Mann-Whitney U Test for inter-group comparisons and the Wilcoxon Signed-Rank Test for intra-group analyses. A critical significance threshold was set at .05, where a p-value less than .05 was interpreted as indicative of a statistically significant difference between groups, whereas a p-value greater than .05 denoted the absence of significant disparities (Büyüköztürk, 2014).

Findings

The quantitative findings obtained from the study investigating the effect of the Web 2.0 Supported Number Sense Program on children's number sense skills are presented between Tables 3 and 9.

Table 3.
Results Related to the Number of Students, Mean, and Standard Deviation Scores for the Pre-Test Scores of the Number Sense Screener for First-Grade Students Attending the Experimental and Control Group

Group	Number Sense Screener	n	$\bar{x}$	SD
Experiment	Counting Skills	23	2.826	.491
	Number Recognition	23	.609	.941
	Number Comparisons	23	3.696	1.743
	Nonverbal Calculation	23	1.913	1.041
	Story Problems	23	1.391	1.033
	Number Combinations	23	1.652	1.873
	Number Sense Screener Total	23	12.087	5.151
Control	Counting Skills	21	2.714	.561
	Number Recognition	21	.952	1.244
	Number Comparisons	21	3.429	1.720
	Nonverbal Calculation	21	1.905	.944
	Story Problems	21	1.381	1.322
	Number Combinations	21	1.095	1.513
	Number Sense Screener Total	21	11.476	5.066

Upon examining the results related to the number of students, mean, and standard deviation scores for the pre-test scores of the Number Sense Screener for first-grade students attending the experimental and control groups in Table 3, it is observed that the number of students in all sub-dimensions for the experimental group is 23. Moreover, in the experimental group, the Counting Skills sub-dimension ($\bar{x}$ =2.826; SD=.491), Number Recognition sub-dimension ($\bar{x}$ =.609; SD=.941), Number Comparisons sub-dimension ($\bar{x}$ =3.696; SD=1.743), Nonverbal Calculation sub-dimension ($\bar{x}$ =1.913; SD=1.041), Story Problems sub-dimension ($\bar{x}$ =1.391; SD=1.033), Number Combinations sub-dimension ($\bar{x}$ =1.652; SD=1.873), and the total Number Sense Screener ($\bar{x}$ =12.087; SD=5.151) are noted. Similarly, for the control group, the Counting Skills sub-dimension ($\bar{x}$ =2.714; SD=.561), Number Recognition sub-dimension ($\bar{x}$ =.952; SD=1.244), Number Comparisons sub-dimension ($\bar{x}$ =3.429; SD=1.720), Nonverbal Calculation sub-dimension ($\bar{x}$ =1.905; SD=.944), Story Problems sub-dimension ($\bar{x}$ =1.381; SD=1.322), Number Combinations sub-dimension ($\bar{x}$ =1.095; SD=1.513), and the total Number Sense Screener ($\bar{x}$ =11.476; SD=5.066) have been determined.

Table 4.
Mann Whitney U Test Results Related to the Pre-Test Scores of the Number Sense Screener for First-Grade Students in the Experimental and Control Groups

Number Sense Screener	Group	n	Mean Rank	Rank Sum	U	Z	P
Counting Skills	Experiment	23	23.59	542.50	216.500	.876	.381
	Control	21	21.31	447.50			
Number Recognition	Experiment	23	20.91	481.00	205.00	.952	.341
	Control	21	24.24	509.00			
Number Comparisons	Experiment	23	23.54	541.50	217.50	.575	.565
	Control	21	21.36	448.50			
Nonverbal Calculation	Experiment	23	22.54	518.50	240.50	.025	.980
	Control	21	22.45	471.50			
Story Problems	Experiment	23	23.35	537.00	222.00	.479	.632
	Control	21	21.57	453.00			
Number Combinations	Experiment	23	24.28	558.50	200.50	1.014	.311
	Control	21	20.55	431.50			
Number Sense Screener Total	Experiment	23	23.52	541.00	218.00	.555	.579
	Control	21	21.38	449.00			

Upon analyzing Table 4, it has been determined that there is no significant difference between the pre-test mean scores of students in the experimental and control groups across all sub-dimensions of the Number Sense Screener; Counting Skills (U=.876, p>.05), Number Recognition (U=.952, p>.05), Number Comparisons (U=.575, p>.05), Nonverbal Calculation (U=.025, p>.05), Story Problems (U=.479, p>.05), Number Combinations (U=1.014, p>.05), and the total score of the Number Sense Screener (U=.555, p>.05). Accordingly, it can be stated that first-grade students in both the experimental and control groups possess similar characteristics in terms of number sense skills at the commencement of the education program. In research employing a pre-test post-test control group design, it is crucial for the pre-test scores of the experimental and control groups to be closely matched (Kaptan, 1998). This condition is significant in demonstrating the effectiveness of the education program applied to the experimental group.

Table 5.
Wilcoxon Signed-Rank Test Results for the Pre-Test / Post-Test Scores of the Number Sense Screener among First-Grade Students in the Experimental Group

Number Sense Screener	Pre / Post-Test	n	Mean Rank	Sum of Rank	z	p
Counting Skills	Negative Rank	0	.00	.00	1.414	0.157
	Positive Rank	2	1.50	3.00		
	Ties	21	-	-		
Number Recognition	Negative Rank	0	.00	.00	4.054	0.000*
	Positive Rank	21	11.00	231.00		
	Ties	2	-	-		
Number Comparisons	Negative Rank	0	.00	.00	3.85	0.000*
	Positive Rank	19	10.00	190.00		
	Ties	4	-	-		
Nonverbal Calculation	Negative Rank	0	.00	.00	3.8	0.000*
	Positive Rank	18	9.50	171.00		
	Ties	5	-	-		
Story Problems	Negative Rank	1	3.00	3.00	4.135	0.000*
	Positive Rank	22	12,41	273.00		
	Ties	0	-	-		
Number Combinations	Negative Rank	0	.00	.00	4.125	0.000*
	Positive Rank	22	11.50	253.00		
	Ties	1	-	-		
Number Sense Screener Total	Negative Rank	0	.00	.00	4.203	0.000*
	Positive Rank	23	12.00	276.00		
	Ties	0	-	-		

*p<.05

Upon reviewing Table 5, the results of the Wilcoxon Signed-Rank Test conducted with the experimental group data indicate statistically significant differences between the pre-test and post-test scores for the Number Sense Screener's sub-dimensions and overall score. Significant improvements were observed in Number Recognition (z= 4.054, p<.05), Number Comparisons (z=3.850, p<.05), Nonverbal Calculation (z=3.800, p<.05), Story Problems (z=4.135, p<.05), Number Combinations (z=4.125, p<.05), and the total score of the Number Sense Screener (z=4.203, p<.05). However, no significant difference was detected in the Counting Skills sub-dimension (z=1.414, p>.05). Consequently, it can be inferred that the post-test mean scores for the sub-dimensions of number sense skills and the total score are higher than the pre-test mean scores. This outcome suggests that the Web 2.0 supported number sense activities within the scope of this research effectively contributed to the development of students' number sense skills.

Table 6.
Wilcoxon Signed-Rank Test Results for the Pre-Test / Post-Test Scores of the Number Sense Screener among First-Grade Students in the Control Group

Number Sense Screener	Pre-Test Post-Test	n	Mean Rank	Sum of Rank	z	p
Counting Skills	Negative Rank	2	3.00	6.00	.447	0.655
	Positive Rank	3	3.00	9.00		
	Ties	16	-	-		
Number Recognition	Negative Rank	1	4.00	4.00	3.411	0.001*
	Positive Rank	15	8.80	132.00		
	Ties	5	-	-		
Number Comparisons	Negative Rank	1	5.50	5.50	3.81	0.000*
	Positive Rank	19	10.76	204.50		
	Ties	1	-	-		
Nonverbal Calculation	Negative Rank	3	5.00	15.00	2.217	0.027*
	Positive Rank	10	7.60	76.00		
	Ties	8	-	-		
Story Problems	Negative Rank	2	5.00	10.00	3.494	0.000*
	Positive Rank	17	10.59	180.00		
	Ties	2	-	-		
Number Combinations	Negative Rank	7	5.14	36.00	3.842	0.000*
	Positive Rank	13	13.38	174.00		
	Ties	1	-	-		
Number Sense Screener Toplam	Negative Rank	1	2.50	2.50	3.933	0.000*
	Positive Rank	20	11.43	228.50		
	Ties	0	-	-		

*p<.05

Upon reviewing Table 6, according to the Wilcoxon Signed-Rank Test conducted with the control group data, it has been determined that there is a statistically significant difference between the pre-test and post-test scores of the Number Sense Screener's sub-dimensions and total; specifically, in the sub-dimensions of Number Recognition (z= 3.411, p<.05), Number Comparisons (z=3.810, p<.05), Nonverbal Calculation (z= 2.217, p<.05), Story Problems (z=3.494, p<.05), Number Combinations (z=3.842, p<.05), and the total score of the Number Sense Screener (z=3.933, p<.05). However, no significant difference was found in the Counting Skills sub-dimension (z= .447, p>.05). Accordingly, it is observed that the mean scores of the post-test for the sub-dimensions and total of children’s number sense skills are higher than the pre-test mean scores. Based on this result, it can be said that the number sense activities applied to the control group within the scope of the research were effective in supporting the development of students' number sense skills.

Table 7.

Results Related to the Number of Students, Mean, and Standard Deviation Scores for the Post-Test Scores of the Number Sense Screener among First-Grade Students in the Experimental and Control Groups

Group	Number Sense Screener	n	$\bar{x}$	SD
Experiment	Counting Skills	23	2.913	.417
	Number Recognition	23	2.608	1.076
	Number Comparisons	23	6.087	1.411
	Nonverbal Calculation	23	3.217	.902
	Story Problems	23	4.043	1.397
	Number Combinations	23	5.087	1.378
	Number Sense Screener Toplam	23	23.956	5.772
Control	Counting Skills	21	2.761	.538
	Number Recognition	21	2.047	1.321
	Number Comparisons	21	4.809	1.860
	Nonverbal Calculation	21	2.476	1.167
	Story Problems	21	2.666	1.238
	Number Combinations	21	3.619	1.856
	Number Sense Screener Toplam	21	18.381	7.003

Upon reviewing the results related to the number of students, mean, and standard deviation scores for the post-test scores of the Number Sense Screener among first-grade students in the experimental and control groups as presented in Table 7, it is noted that the number of students in all sub-dimensions for the experimental group is 23. Furthermore, in the experimental group, the Counting Skills sub-dimension ($\bar{x}$ =2.913; SD=.417), Number Recognition sub-dimension ($\bar{x}$ =2.608; SD=1.076), Number Comparisons sub-dimension ($\bar{x}$ =6.087; SD=1.411), Nonverbal Calculation sub-dimension ($\bar{x}$ =3.217; SD=.902), Story Problems sub-dimension ($\bar{x}$ =4.043; SD=1.397), Number Combinations sub-dimension ($\bar{x}$ =5.087; SD=1.378), and the total Number Sense Screener ($\bar{x}$ =23.956; SD=5.772) have been observed. Similarly, for the control group, the Counting Skills sub-dimension ($\bar{x}$ =2.761; SD=.538), Number Recognition sub-dimension ($\bar{x}$ =2.047; SD=1.321), Number Comparisons sub-dimension ($\bar{x}$ =4.809; SD=1.860), Nonverbal Calculation sub-dimension ($\bar{x}$ =2.476; SD=1.167), Story Problems sub-dimension ($\bar{x}$ =2.666; SD=1.238), Number Combinations sub-dimension ($\bar{x}$ =3.619; SD=1.856), and the total Number Sense Screener ($\bar{x}$ =18.381; SD=7.003) have been determined.

Table 8.

Mann Whitney U Test Results Related to the Post-Test Scores of the Number Sense Screener among First-Grade Students in the Experimental and Control Groups

Number Sense Screener	Group	n	Mean Rank	Rank Sum	U	Z	p
Counting Skills	Experiment	23	23.98	551.50	207.500	1.450	.147
	Control	21	20.88	438.50			
Number Recognition	Experiment	23	25.20	579.50	179.500	1.511	.131
	Control	21	19.55	410.50			
Number Comparisons	Experiment	23	26.76	615.50	143.500	2.397	.017*
	Control	21	17.83	374.50			
Nonverbal Calculation	Experiment	23	26.72	614.50	144.500	2.467	.014*
	Control	21	17.88	375.50			
Story Problems	Experiment	23	28.61	658.00	101.000	3.399	.001*
	Control	21	15.81	332.00			
Number Combinations	Experiment	23	27.74	638.00	121.000	2.928	.003*
	Control	21	16.76	352.00			
Number Sense Screener Toplam	Experiment	23	28.26	650.00	109.000	3.126	.002*
	Control	21	16.19	340.00			

*p<.05

Upon examining Table 8, it has been determined that there is no significant difference between the post-test mean scores of students in the experimental and control groups for the Number Sense Screener in the Counting Skills (U=1.450, p>.05) and Number Recognition (U=1.511, p>.05) sub-dimensions. However, significant differences were found in the Number Comparisons (U=2.397, p<.05), Nonverbal Calculation (U=2.467, p<.05), Story Problems (U=3.399, p<.05), Number Combinations (U=2.928, p<.05) sub-dimensions, and the total score of the Number Sense Screener (U=3.126, p<.05). Therefore, considering the sub-dimensions and total scores of the Number Sense Screener, it can be stated that at the end of the educational intervention, students in the experimental group exhibited superior number sense skills compared to those in the control group.

Table 9.

Wilcoxon Signed-Rank Test Results for the Post-Test / Retention Test Scores of the Number Sense Screener among First-Grade Students in the Experimental Group

Number Sense Screener	Pre-Test Post-Test	n	Mean Rank	Sum of Rank	z	p
Counting Skills	Negative Rank	0	.00	.00	1	0.317
	Positive Rank	1	1.00	1.00		
	Ties	22	-	-		
Number Recognition	Negative Rank	2	6.00	12.00	2.324	0.020*
	Positive Rank	10	6.60	66.00		
	Ties	11	-	-		
Number Comparisons	Negative Rank	4	5.50	22.00	0.632	0.527
	Positive Rank	6	5.50	33.00		
	Ties	13	-	-		
Nonverbal Calculation	Negative Rank	1	5.00	5.00	2.333	0.020*
	Positive Rank	8	5.00	40.00		
	Ties	14	-	-		
Story Problems	Negative Rank	3	3.50	10.50	0.632	0.527
	Positive Rank	4	4.38	17.50		
	Ties	16	-	-		
Number Combinations	Negative Rank	3	4.50	13.50	0.707	0.480
	Positive Rank	5	4.50	22.50		
	Ties	15	-	-		
Number Sense Screener Toplam	Negative Rank	2	4.00	8.00	2.841	0.004*
	Positive Rank	12	8.08	97.00		
	Ties	9	-	-		

*p<.05

Upon reviewing Table 9, according to the Wilcoxon Signed-Rank Test conducted with the experimental group's data, a significant difference was identified between the post-test scores and the retention test scores in the sub-dimensions of the Number Sense Screener and the overall scores statistically; significant differences were found in Number Recognition (z= 2.324, p<.05), Nonverbal Calculation (z= 2.333, p<.05), and the total score of the Number Sense Screener (z=2.841, p<.05). However, no significant difference was detected in the Counting Skills (z= 1.000, p>.05), Number Comparisons (z=0.632, p>.05), Story Problems (z=0.632, p>.05), and Number Combinations (z=0.707, p>.05) sub-dimensions. Accordingly, it can be observed that the children's number sense abilities in the sub-dimensions of Number Recognition, Nonverbal Calculation, and the total retention test scores of the Number Sense Screener were higher than the post-test scores. This outcome may suggest that the continued engagement of students with the Web 2.0 tool-supported content related to the Number Sense activities applied to the experimental group could be attributed to the practices continued by the students after the application phase.

Discussion, Conclusion, and Recommendations

In the study examining the effect of the Number Sense Education Program Supported by Web 2.0 Tools on number sense skills, it was determined that there was no significant difference between the pre-test average scores of the experimental group students, to whom the Web 2.0 Supported Number Sense Education Program was applied, and the control group students, to whom the existing teaching program was applied, across the Number Sense Screener sub-dimensions and total scores. A statistically significant difference was found between the pre-test and post-test scores of the experimental group students in the sub-dimensions of Number Recognition, Number Comparisons, Nonverbal Calculation, Story Problems, Number Combinations, and in the total score of the Number Sense Screener. However, no significant difference was identified in the Counting Skills sub-dimension between the pre-test and post-test scores of the experimental group students. In summary, it can be said that the children's average scores in number sense skills were higher than their average pre-test scores. Based on this research outcome, it can be stated that number sense activities supported by Web 2.0 tools are effective in developing students' number sense skills. When examining the difference between the pre-test and post-test scores of the control group students, a significant difference was found in the sub-dimensions of Number Recognition, Number Comparisons, Nonverbal Calculation, Story Problems, Number Combinations, and in the total score of the Number Sense Screener. However, no significant difference was identified in the Counting Skills sub-dimension. Therefore, it can be said that the children's average scores on the Number Sense Screener were higher than their pre-test average scores. This situation is thought to be due to the acquisition of outcomes and indicators related to number sense included in the Ministry of National Education's First Grade Mathematics Course Teaching Program (2018) during the research process. When comparing the post-test average scores of the experimental and control groups, a significant difference was found in favor of the experimental group across the Number Sense Screener sub-dimensions and the total. This result serves as evidence of the positive effect of educational processes supported by Web 2.0 tools on the development of students' number sense skills. Finally, analyses of the experimental group students' post-test and follow-up test scores revealed that the averages of the Number Recognition and Nonverbal Calculation sub-dimensions, as well as the total follow-up test scores of the Number Sense Screener, were significantly higher than the post-test averages. This outcome is thought to result from the students' continued engagement with the content prepared with Web 2.0 tools even after the experimental application.

In the literature, regarding the developmental trajectory of number sense during the preschool and elementary school periods, Gözüm et al. (2024) conducted a latent profile analysis to identify the number and proportions of distinct number sense profiles, the variables influencing these profiles, and the characteristics of children with different profiles during the transition from preschool to elementary school. The number sense profiles of preschool and first-grade students were identified as significantly below average, below average, and above average. The average scores for both early number knowledge and arithmetic skills of first-grade and preschool children were below average in Profile I (moderate very low, 9.20%) and Profile II (moderate low, 24.50%). It was found that 33.70% of the children, whose arithmetic skills were expected to develop through preschool mathematics education, scored below average in arithmetic skills. However, 66.30% of the children starting first grade displayed an above-average profile (Profile III). Among the preschool children who participated in this study, the proportions of those in Profile I (moderate very low, 51.90%), Profile II (moderate low, 13.00%), and Profile III (moderate high, 35.10%) showed that the majority were in Profile I. A total of 64.90% of preschool children were found to have below-average number sense skills. The researchers suggested that these results indicate that children’s number sense skills develop more significantly in elementary school than during the preschool period, emphasizing the critical importance of mathematical activities conducted in first grade. Additionally, the researchers highlighted that supporting the counting component of the early number knowledge dimension for preschool and first-grade Profile I children is a key method of intervention. This is because the counting component was the critical feature that distinguished Profile I from Profile II and Profile III in both preschool and first-grade students. It was noted that children whose counting component does not develop during the transition from preschool to elementary school may face risks in their number sense development and

mathematics achievement in later years. Similarly, Nelwan et al. (2021) found that number sense contributes to the mathematical development of children with and without mathematical difficulties starting from first grade. These studies collectively underscore the developmental significance of number sense in first grade and the importance of number sense activities conducted at the first-grade level.

Additionally, the literature includes studies demonstrating the impact of intervention programs on students' number sense skills. In Gillespie's (2021) research, while conducting "Number Talks" activities with the experimental group, traditional mathematics lessons were carried out. The study concluded that students in the experimental group significantly outperformed the control group in both number sense and mathematical discourse skills. Similarly, Tucker and Johnson (2022) explored the impact of a touchscreen digital game called Fingu on the development of number sense in preschool children. An increase in number sense skills and mathematical thinking was observed among children who played the Fingu game. In this context, the use of digital tools has been highlighted for its contributions to the development of children's mathematical skills, particularly in enhancing their number sense. Verzosa and colleagues (2021) developed and implemented a number line mobile application using gamification techniques for students from 1st to 7th grade to instill number estimation and number sense skills. The results indicated that the mobile application primarily increased students' motivation and had a positive effect on the development of number estimation and number sense skills. Liang et al. (2020) reported that a Response to Intervention (RtI) model-based mathematics game training for socially disadvantaged preschool children had a positive impact on their development of number sense. Azid and colleagues (2020) investigated the effect of using Web 2.0 tools on students' mathematics achievement; they found that the experimental group, which used Web 2.0 tools, showed improved mathematics achievement, enjoyed the learning process, were motivated to complete tasks during lessons, and exhibited increased interest. Hulse and colleagues (2019) explored the impact of a game-based approach called "From Here to There! Elementary" on developing number sense and early algebra skills among second-grade elementary students. They concluded that the game effectively enhanced students' number sense and early algebra skills in mathematics education. According to Papadakis et al. (2016), technological tools offer innovative opportunities to support mathematical achievement when used appropriately for children's developmental stages. In an experimental study conducted by Papadakis et al. (2018), it was found that mathematical activities involving technological tools supported children's understanding of numbers. Similarly, Benavides-Varela et al. (2020) conducted a meta-analysis of empirical evidence on the effectiveness of digital-based interventions for students with mathematical learning difficulties and found that such interventions generally improved mathematical performance (mean effect size = 0.55). Lastly, Yazıcı et al. (2023) demonstrated in their research that Web 2.0-supported geometry activities effectively improved preschool children's geometry skills. Thus, the research outcomes mentioned above support the findings that the number sense skills of students in the experimental group improved positively from before to after the educational intervention.

In the Number Sense Education Program Supported by Web 2.0 Tools, the activities and lesson plans prepared with Web 2.0 tools were designed to align with students' developmental characteristics and to specifically target their number sense skills. The program is entirely child-centered, allowing for an in-depth, systematic, and sequential exploration of the dimensions of number sense skills. It focuses on game-based learning and ensures that students enjoy engaging in the activities prepared with Web 2.0 tools. The arrangement of activities from simple to complex, the inclusion of both collaborative and individual exploratory learning opportunities, and the integration of multiple activities for each learning outcome and development indicator, suggest that such features have contributed to the development of number sense skills among students in the experimental group.

In this study, limited by the number of children in the group and the activities included in the Web 2.0 Supported Number Sense Education Program, it has been concluded that the program is effective in supporting students' number sense skills. In this context, the following suggestions can be offered:

This research, conducted with first-grade students and limited to the duration of the study, suggests that longitudinal studies with larger groups could be conducted to further investigate the effectiveness of Web 2.0 tools on number sense.

Seminars, conferences, and similar events could be organized for teachers on integrating Web 2.0 tools with lesson topics. This would ensure that teachers become informed about the subject and gain awareness of using Web 2.0 tools.

Elective courses at both undergraduate and postgraduate levels could be offered that include topics on integrating Web 2.0 tools with lesson subjects through example educational practices for teacher candidates.

Building on the effects of Web 2.0 tools on the development of number sense in first-grade students, this method could be explored and applied in number sense topics within mathematics lessons at different grade levels, with results presented in report form.

Following this study, further research could be conducted on the effectiveness of Web 2.0 tools with different course contents. The outcomes of such studies, including both positive and negative results, could be shared with researchers, teachers, students, and administrators.

By integrating Web 2.0 tools with foundational educational practices, students' interest in lessons can be maintained and their motivation increased, supporting the retention of what is learned.

Studies supported by Web 2.0 Tools could be conducted on topics where students generally struggle to learn, allowing for an evaluation of learning processes.

Acknowledgment

Ethics statement: In this study, we declare that the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with and that we do not take any of the actions based on "Actions Against Scientific Research and Publication Ethics". At the same time, we declare that there is no conflict of interest between the authors, which all authors contribute to the study, and that all the responsibility belongs to the article authors in case of all ethical violations.

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