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Examining YouTube Videos with Counting and Numbers Content for Preschool Children

***Şeyma Şengil Akar**

Abstract. Children, who are introduced to technology as soon as they are born, have access to internet-based videos as young as one year old. These colourful, animated cartoon/animation content supported by songs have turned into informal learning tools for children. Some of these videos, which families do not hesitate to present as educational content, are math videos. These videos reach millions of views. These videos with mathematical content prepared for children, mostly shared with the label of children's songs, are the subject of this study. In this study, we focused on Turkish number and counting videos from the open access YouTube content provider. Document analysis method was used in this study. As a result of the analysis, it was observed that only a few videos were adequate in terms of mathematical language, content and number teaching, and almost all of the other videos included incorrect or inaccurate mathematical representations. While counting, it was observed that number symbols were used as "ordinal numbers". In addition, it was observed that there were scenes where the amount counted and the number did not match. It was thought that these situations could lead to false learning. Based on all these findings, it can be concluded that the mathematical language used in YouTube video content is weak.

Keywords. Numbers, counting, early childhood, YouTube, video content.

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As a result of the widespread use of the Internet and the ease of access to digital technologies, it is known that the age of access to video content platforms such as has decreased until early childhood (Nansen et al., 2016) in last decade. In early childhood, it has been observed that children use technologies such as tablets and cell phones from twelve months of age and can access content (Hourcade et al., 2015). Many children are offered digital content, especially cartoon/animation videos, by their parents or caregivers (Neumann & Herodotou, 2020). In the preschool period, especially the content in the videos classified as educational content is presented to children with a positive perspective by parents, caregivers and teachers (Gözen et al., 2021; Puspita et al., 2022), and according to research, 80% of 0-7-year-old children watch songs/cartoons/animations in these digital content before going to school (Neumann & Herodotou, 2020). From this point of view, it can be said that digital content environments such as YouTube exist as a non-formal learning tool in children's lives. In addition, preschool and classroom teachers use media technologies, especially cartoons, videos, and animations in different lessons in their classes (Veziroğlu-Çelik et al., 2018). When the content of YouTube Turkish children's channels is searched with the keywords "numbers, counting", it can be seen that among the video materials that children encounter through songs, cartoons and animations, there are also mathematical contents for counting or recognizing numbers. These contents may be the first contents about numbers that children encounter for number teaching.

Numbers is a learning domain that forms the basis of mathematics and all content is constructed in relation to the learning domain of numbers (Van de Walle et al., 2014). Children start learning mathematics with counting skills and this skill is realized in early childhood (Akkaya, 2019; Akman, 2002; Baroody et al., 2009; Kilpatrick et al., 2001; Taşkın, 2019; Van de Walle et al., 2014). Number is an abstract concept, but if the learning of numbers in the preschool period progresses with the right support, the concept of number and number sense develops in children (Baroody et al., 2009; Olkun & Toluk-Uçar, 2007). Number sense, in its simplest definition, includes skills such as understanding numbers conceptually, establishing numerical relationships between numbers, recognizing the magnitudes of numbers and comparing numbers, developing reference points for comparisons, and understanding numerical operations using the relationships of numbers (Berch, 2005; Baroody et al., 2009; NCTM, 1998; Reys et al., 1999). In these definitions, the first emphasis is on understanding numbers conceptually and comparing numbers. Making sense of numbers also begins in early childhood (Sarnecka & Carey, 2008; Olkun & Toluk-Uçar, 2005) and numerical relationships and skills developed in early childhood form the basis of all arithmetic skills of children (Frye et al., 2013; Geary, 2015). For example, the number 17 is less than 18 but greater than 16, and this number is closer to 20. It can also be represented as 15+2 or 20-3. Many of these numerical relationships are similar for 578 and 2319, and these simple numerical associations generalize to larger numbers as children grow older. Learning constructed through mislearning in the early period and skills that are not developed (conceptual understanding of numbers, comparing, referencing, etc.) constitute the root of the difficulties that may be encountered in the future (Reid, 2016). In addition, it has been observed that children who lack mathematical skills in early childhood lag behind children who are better in mathematics in later years (Aubrey et al., 2006; Clements & Sarama, 2007).

Studies have shown that learning numbers is inseparable from number sense skills (Kayhan-Altay, 2010; Sarnecka & Carey, 2008,). While perceiving multiplicities begins in infancy, counting begins to develop from the age of two and by the age of six, a child can count almost like an adult (Sezer, 2008). In order to acquire counting skills, principles such as the cardinal number principle (the last number represents quantity), the one-to-one matching principle, the principle of abstraction, the principle of conservation and the principle of ordinal independence need to be established in children (Alptekin, 2015, Frye, 2013). Therefore, the processes related to counting skills in early childhood are meaningful. Counting skill develops in six stages: "understanding quantity, rote counting, asynchronous counting, simultaneous counting, concurrent counting, consequential counting, and abbreviated counting" (Akkaya, 2019). The first stage is the stage of visual understanding of quantity and amount. In the first stage of this development, children begin to be able to compare quantities that are more or less, while in the last stage, they can comprehend, group and subitize the number of multiplicities in their minds without the need to count. (Frye et al., 2013; Sarnecka & Carey, 2008; Sarnecka & Lee, 2009). Children construct the concept of number abstractly in their minds by seeing quantities of different numbers (between 1-10) together and visualizing them in their minds (Sarnecka & Carey, 2008). The skill that is confused with the counting skill and subitizing given above is the ability to recognize and write numbers (Van De Walle et al., 2014). The fact that children recognize and read/write certain numbers in early childhood leads early childhood teachers and parents to think that children understand the concept of number. However, before children learn to write "table" in the first grade, they encounter table objects in many different ways and form an image of this concept in their minds before writing "table". The fact that preschool children can read the number “seven” does not mean that they can visualize the magnitude of the number “seven” in their minds or that they can relate this number to other numbers. This is because this skill is a skill like literacy and is different from other skills related to counting (Van De Walle et al., 2014). In addition, studies have not found a direct relationship between quantity perception and writing symbols of numbers (Hannula et al., 2007). In order for counting to continue in a sequential manner, the numbers in the first ten must first be established quantitatively, conceptually and in number order (Frye et al., 2013; Sarnecka & Lee, 2009; Van de Walle et al., 2014,). Realizing the meaning between the number two and the number three in counting occurs when the child conceptually realizes the difference in quantity (Olkun & Toluk-Uçar, 2007).

With children's access to technology, it is seen that children learn different information directly from these technologies in an informative way (Veziroğlu-Çelik et al., 2018). When video content is prepared according to children's ages, cognitive development levels and appropriate skills with audio and visual supports, children can learn various information that is readily available from digital content, media and screens (Heintz & Wartella, 2012). Informal knowledge is defined as the knowledge that children learn in daily life through real-life experiences without a specific program purpose outside of school (Saraç, 2017). Considering the number of views on YouTube, which is the most important digital content provider in Turkiye, it can be thought that this content is an important resource for children to learn numbers, considering that a video with number content used in this study has reached "one hundred and seventy-five million" views. However, does this resource present mathematical content accurately? We only see the objects in the videos for a few seconds in front of a limited screen. For example, counting a group of objects passing through the screen one by one can be a difficult visualization for a child to understand, since he/she does not know where the object comes from and where it goes, since not all of the quantity is visible, since it is not clear from the visual whether the object is the same or different. In this context, it can be expected that these animated animations/cartoons supported by various sounds and visuals should be well-constructed, composed of interconnected images, emphasizing the continuity of the object, well-grounded and have accurate mathematical content.

There are some studies examining children's learning processes with YouTube content (Gülmez, 2019; Mulyana et al., 2022). In a study on reading numbers in early childhood with YouTube content, it was observed that preschool children's level of reading numbers increased with YouTube video content (Mulyana et al., 2022). In his study, Gülmez (2019) presented video content specially prepared by subject to students via YouTube and investigated whether there was a significant difference in children's concept learning. As a result of this study, there was a significant difference in favor of the experimental group in learning some concepts (Gülmez, 2019). From this point of view, it is thought that the content presented contributes to children's learning and creates an informal learning environment. The subject of this study is whether the mathematical language and representations of these colourful, attractive, child-oriented contents, which are watched by millions of viewers and mostly shared with the label of children's songs, are appropriate.

In this context, the aims of this study is to examine the general structure, mathematical language and content of numbers/counting videos on YouTube in terms of supporting counting skills and number sense. In this context, this study will examine the most watched Turkish short videos (songs, cartoons) on YouTube and discuss the contribution of these contents to the correct construction and development of number concept in children. The following are the research questions of this study.

1. What are the general purposes (e.g., instructional goals) of the content of the most watched numbers/counting videos?

2. How are mathematical language and representations used in numbers/counting videos that are expected to support counting ability and number sense?

Method

In this study, document analysis, one of the qualitative research methods, was used. Although document analysis is sometimes considered as a complementary data collection method, it is also seen as a part of methodology in qualitative research (Bowen, 2009; Wach & Ward, 2013, Merriam, 2009). Documents are resources that are readily available in written, audio-recorded, video or visual form. Documents are an important element used in qualitative research for many years (Merriam, 2009). Types of documents include books, letters, journals, diaries, maps, charts, statistics, constitutions and regulations, legal texts, newspapers, photographs, memoirs, interviews, school records, health and public records, pictures, videos, messages, and so on. In this research, YouTube data is considered as a document since it is a direct open access resource that can be accessed by everyone, especially children. The following section details the sampling, data collection and data analysis stages.

Research Documents and Data Collection

The data of the study are videos on YouTube content Turkish provider that contain number teaching for children. This research is limited to Turkish-language video content originating from Turkiye. These videos constitute the data set of the study. Criterion sampling was used to select these videos. These criteria are; "videos that correspond to the search for some keywords, have a single video content, are aimed at early childhood, are produced by children's video content channels, are shorter than five minutes, and are widely watched". When the Turkish keywords "numbers, counting, I am learning to count, I am counting, I am learning numbers, I am counting, I am learning numbers, digits" were searched through the YouTube content provider, the videos were sorted from the most watched to the least watched, and the main data source of this study was created. First, the above keywords were entered into the YouTube search engine. Then, videos for children in terms of content were listed by selecting those related to these keywords. Since some videos were shared by more than one channel, the most watched of these videos were selected as the source. In the lists in this context, those with the same video content and video content created by collage with more than one video were eliminated and the videos were sorted from the most watched to the least watched. On this basis, selection was made based on the total number of views. The selected videos were those with only one video content. As of the date the researcher downloaded these videos for video analysis (Feb 2023), the most viewed videos were "one hundred and seventy-five million" and the least watched videos were approximately "three million". However, it can be assumed that these videos may have been watched more, as there are different video copies of these videos and some of the views may be due to multiple people sharing a single screen. The list below lists the name of the relevant videos, the link to the videos for easy access by readers, the video channels that provided the videos, the date the videos were uploaded and the number of views.

Table 1.

Information about videos

No:	**Name of Video (Tr and Eng) Link**	**Channel**	**Upload.Date**	**Nr of View**
1.	Sayılar- Sevimli Dostlar çizgi film çocuk şarkıları 2017 (Numbers- Cute Friends cartoon kids songs 2017) https://youtu.be/nxsleDObpYo	Sevimli Dostlar (Cute Friends)	10.06.17	175.802.824
2.	5 Küçük Ördek (5 Little Duck) https://youtu.be/LVeQBh5qu08	Mini Anima	12.02.17	87.366.600
3.	1 den 10 ‘a kadar sayıları öğreniyoruz (Learning numbers from 1 to 10) https://youtu.be/iSFG5FGEV0Q	Tino Oyuncalar &Çocuklar	09.20.19	25.033.677
4.	10 küçük araba-Sayı saymayı öğreniyoruz (10 small cars-Learning to count) https://youtu.be/8h9UJqSYuyI	Afacan Tv	04.12.17	19.536.291
5.	Haydi Saysana Let's Count https://youtu.be/NF0pYmopVbY	Edis & Feris	09.05. 14	19.312.143
6.	10 küçük aslancık / Saymayı öğreniyoruz (10 little lions / Learning to count) https://youtu.be/XSCkVl2mOP0	Afacan Tv	03.07.14	8.203.250

7.	Sayım Şarkısı/ Charlise & the Numbers ile 1den 10a kadar sayılarla tanışın (Meet numbers from 1 to 10 with the Counting Song / Charlise & the Numbers) https://youtu.be/mIJePQ2shPc	Baby Tv	07.17.14	7.870.740
8.	Doru Atı Eğitici Çizgi Film, Sayılar ve Renkler (Doru Horse Educational Cartoon, Numbers and Colors) https://youtu.be/jz2BFpkOrqE	Agubebe tv	07.01.17	6.736.869
9.	Hodo ile Sayıları Öğreniyoruz (Learning Numbers with Hodo) https://youtu.be/rhgHZzitf9Q	Çocuk Diyarı	05.23.18	5.607.604
10.	1,2,3,4,5 ile birlikte saymaya ne dersiniz? /Sevimli Dostlar Bebek Şarkıları (How about counting with 1,2,3,4,5? /Cute Friends Baby Songs) https://youtu.be/UClsM1esRu8	Sevimli Dostlar	01.25.20	5.598.860
11.	Sayılar /1den 20 e kadar Türkçe Sayılar (Numbers / Turkish Numbers from 1 to 20) https://youtu.be/FLrpcOgTvwc	Mini Baykuş	05.21.16	4.635.076
12.	Sağ Elimde Beş Parmak (Say Bak) Şarkısı ve Sözleri (Five Fingers on My Right Hand (Count) Song and Lyrics https://youtu.be/uf_EN3axLmw	Alpi ve Arkadaşları	12.09.15	4.444.555
13.	Pepee- Sayılar Şarkısı(pepee- Numbe song) https://youtu.be/VEnFp58n5fE	Düşyeri	01.07.15	3.610.316
14.	Sevimli Dostlar ile sayıları öğreniyorum (Learning numbers with Cute Friends) https://youtu.be/xlwUZW8sjFs	Sevimli Dostlar	11.07.20	3.604. 268
15.	Sevimli Tren Hodo ile Sayıları Öğreniyoruz (Learning Numbers with Hodo the Cute Train) https://youtu.be/0Jda7sUDBgQ	Çocuk Diyarı	04.23.15	2.951.232

Data Analysis

In this study, the documents were analysed by descriptive analysis method (Merriam, 2009). Data analysis took place in three stages. First of all, about fifty videos were analysed on the basis of the research, and criteria were determined by deciding according to which criteria content analysis would be made from these videos. These criteria were the most watched videos with "single video" content for children that met the keywords "numbers, counting, learning to count, counting, learning numbers, numbers". These videos selected in this study constitute the data set of the research. All videos were analysed and transcripts of the visuals of the study were obtained. The selected videos were watched one by one many times and a preliminary analysis was made, and themes and codes were created from these preliminary analyses to analyse the data set of the research. The primary purpose here is to make a holistic analysis of the videos in general. In the preliminary analysis, it was seen that the content of each video had an instructional goal. When analysed on the basis of these goals, the first theme is "instructional purpose". Then, each scene in the video content was analysed one by one, and the mathematical representations of visual and auditory elements were examined. While analysing these videos, relevant codes (showing numbers as multi-digit numbers, the set of counted objects and the counting number not being consistent... etc.) were obtained. Since this list of themes and codes will be presented and discussed in the findings section, no further details are given here to avoid repetition. Within the framework of these themes and codes, detailed examinations were made and the research findings were described.

Reliability, Validity and Ethics

In qualitative research, there is no validity and reliability like quantitative research, but there are some strategies (Merriam, 2009). In this study, direct quotation method was used to increase credibility, and the data obtained by analysing the content of the videos were presented by direct quotation method. In addition, the relevant parts of the videos were screenshotted and given as evidence in the relevant sections. In order to increase the transferability of the research, purposive sampling was used and the inclusion and exclusion criteria were clearly written and detailed.

In order to increase the reliability of the research, after the relevant codes were created, the expert opinion of an academic working in the field of mathematics education was consulted twice. There are two main reasons for seeking expert opinion. The first reason was to confirm the appropriateness of the code list. According to the expert opinion taken in accordance with the purpose in the first stage, the researcher and the expert reached a consensus on the relevant code list. The second purpose was to calculate the inter-rater reliability coefficient. In the second stage of the study, after all videos were analysed, expert opinion was taken to calculate inter-rater reliability. Three videos corresponding to 20% of all videos were analysed by the expert within the framework of the relevant codes, and 92 % consistency was found between the rates. According to Krippendorff (1995), this level of consistency is high (as cited in Bilgen & Doğan, 2017). Since the research was conducted with the document analysis method, open access sources were used, thus avoiding many problems that may be ethical problems, such as publication copyright, conflicts related to the content.

Results

When the videos were analysed, it was deemed appropriate to discuss them under two themes. Under the first theme, the findings regarding the general structure of the video contents will be presented under the theme of "instructional purposes of the videos". Under the second theme, the mathematical representations in the content of the videos will be presented under the theme. All codes and themes are given in a table below.

Table 2.
Themas and Codes

Thema	Code	Video
Purpose of Videos	Videos Focus on Symbol Teaching	5,9,11,15
	Videos Focus on Sequential Counting	4,6,7,13
	Videos focus on Counting Quantities	1,2,3,7,10,12, 14
Mathematical Representations	Using Symbols (Numbers) Only	5,7,9,11,13,15
	Representing Numbers as Multi-Digit Numbers	1,5,7,8,9,10,13,14,15
	Representing Cardinal Numbers as Ordinal Numbers	1, 5, 10,14
	Mismatch Between the Number of Objects Displayed and The Cardinal Numbers	4,6,12
	Failure to Count the of Quantity	1

When all videos are analyzed, only two of the fifteen videos present mathematical content accurately. When the content of the other videos is analyzed, it is seen that there are some problematic sections in terms of presenting mathematical content with correct representations. These sections were analyzed with five codes under the theme of mathematical representations as the table seen above.

General Content of the Videos

When the general content of the videos was analyzed holistically, the theme of "instructional purpose of the videos" was formed. The sub-codes of this theme are as follows: "counting quantities, teaching consecutive numbers videos, teaching symbols of numbers". Detailed analysis of these videos will be presented under the following headings.

Videos focus on symbol teaching. When the contents of the videos were analyzed, the first code under the instructional purpose of the videos was "focused on symbol teaching". All videos in the study (including the 15th video) included symbol representation of numbers. However, the contents of the videos under this theme (videos 5, 9, 11, 15) only address videos that focus on reading the symbols of numbers. In these contents, it is understood that the reading of symbols is tried to be taught by reading or showing each symbol. Four of the fifteen videos were categorized under this theme. These videos are; Lets Count (5th Video), *We Learn Numbers with Hodo* (9th Video), Numbers-1 to 20 (11th Video) and Numbers with Hodo the Cute Train (15th Video). When we watch these videos, it is seen that the video contents are generally prepared for the reading of numbers. For example, the lyrics in English translation and video image of 5th video (Lets Count) are in below.

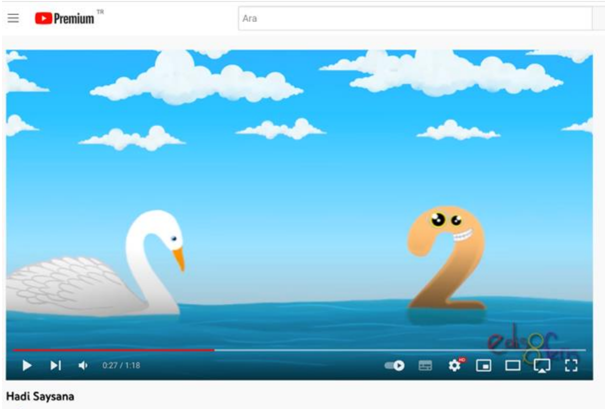
Video Image	Lyrics
	1,2,3,4,5,6,7,8,9,10 1,2,3,4,5,6,7,8,9,10 La la la la la la la, Let's count Numbers start with one, La la la la la la la, Come on, count it, Then comes two, ***Like a swan,*** Three is like a bird, Four, like sails

Figure1. 5th Video Image and Lyrics.

In the song of the video, the general focus is on the reading of all symbols. In the content of the video with lyrics, each number is likened to a figure as seen in the picture. Two is likened to a swan, three is flown like a bird, four is likened to a sail, and the round part of six is depicted as a belly. In the two most watched videos (9th & 15th videos 9) of the same video content producer, the train cars are loaded with number symbols and read in sequence. In another video content (11th video), the numbers between 1-20 are given as symbols and verbally in order. Although this video content was presented in a plain form and was not supported by a song or a rhythm, it was still viewed millions of times.

Videos focus on sequential counting. In the videos collected under this theme (4th, 6th, 7th, 13th), it was observed that sequential counting was more dominant. In these videos, numbers were emphasized by using song-themed content such as 10 little cars (4th video), 10 little lions (6th video), Counting song (7th video), Pepee Numbers Song (13th video), and rhyming one after another. For example, the lyrics and sample video image of the song in the 6th video (10 little Lion) are as follows.

Video Image	Lyrics
	1 little, 2 little ,3 little lion, 4 little, 5 little, 6 little lion, 7 little, 8 little, 9 little lion 10 little lion …

Figure 2. 6th Video Image and Lyrics.

As given in the relevant image and description, a lion is presented on stage in this video content. Lions are seen in the visual from different directions in sequence. In the video where only one lion is seen in each scene, the rhythm and song are quite melodic. It is seen that the main purpose of this video content is to "teach the order of consecutive numbers" accompanied by music and rhythm.

The video content of 6th video (ten little cars) is the lyrics of the same song sung using vehicles. In the video content, a single vehicle appears in each scene and consecutive counting is performed when this single vehicle appears.

In the "counting" song, the rhythmic counting of numbers such as "1,2,3,4,5, 6,7,8,8,9,10" is repeated many times in a row. After this repetition, a rhyming word is sung for each number. Some of the lyrics' translation are quoted directly below:

"My name is a handyman,
My name is two, what's yours?
That's me three, that's hard to do,
Come on, let's dance, one, two, three,
...."
(Baby tv, Turkish Counting Song)

As can be seen in this example, in the content of this video, there are no visuals or lyrics that show the quantitative meaning of number or the relationship between number and multiplicities. To give another similar example, in the 13th video (Pepee numbers), fewer symbols were used and "no" objects were used compared to the other videos; rather, the numbers were counted one after another rhythmically with rhythm and rhymes. It is seen that the "Pepee" video is completely oriented towards teaching counting numbers.

Videos focus on counting quantities. When the video contents are analysed holistically, it can be said that under the third theme, there are videos (1st , 2nd , 3rd , 7th , 10th , 12th and 14th videos) that have content for counting objects. In these videos, it is possible to characterize these videos as object counting videos since they aim to match the numbers with objects as well as showing the numbers with symbols. These video contents aim to develop skills such as counting objects and comparing objects. Under this heading, there are videos that present mathematically correct content (2nd,3rd,4th videos) as well as videos that present conceptually incorrect or incomplete content (e.g., 7th video). Among these videos, the "five little ducks" video (2nd video) and the "How about counting 1,2,3,4,5 together?" video (10th video) are examples of videos with correct mathematical content. In this section, more examples with correct representations will be discussed. Below are the lyrics with translation from Turkish and the screenshot of the video with the correct mathematical representations (2nd video).

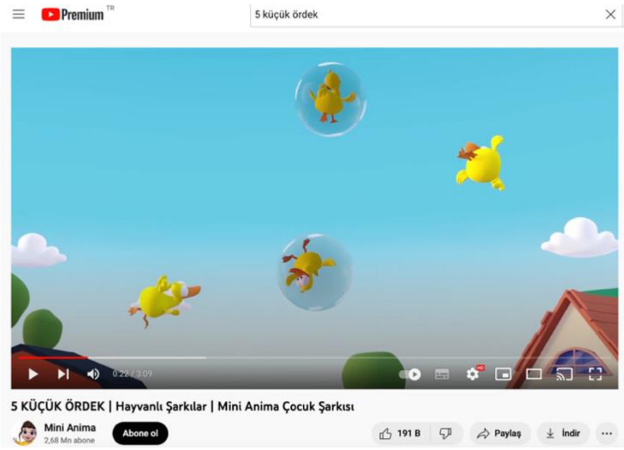
Video Image	**Lyrics**
	One day five little ducks hid in secret, The mother duck quacked, The four ducks are back, One day four little ducks, They hid in secret, The mother duck quacked, The three ducks came back... …….

Figure 3. 2nd Video Image and Lyrics (When it is sang "The four ducks are back".).

The 2nd video titled "Five little ducks" was coded as "videos on counting quantities". This video contains an act of counting backwards from five, as described above through direct quotation. In each scene within the video, the entities to be counted and the way the counting numbers are spoken are consistent. For example, while the song says "four ducks are back", only four ducks are shown on the screen. Although this video does not include the representation of the number with a symbol, since it clearly shows how many quantities the number represents, it can be considered that this video supports number sense and can be a correct tool to be used in teaching the concept of number.

When analyzed in terms of presenting mathematical content, another good example is 3rd video titled "We are learning numbers from 1 to 10". This video is not a video with song content like the other videos. The video depicts an image with a voiceover. For example, the balls are counted one by one as they bounce and get on the wagon. "two, one two, well done green balls", etc. The relevant video content and visuals are presented below.

Video Image	**Video Content**
	In the video, there are numbered wagons and in front of these wagons there are as many balls as the corresponding number. An audio instruction is given. This instruction is: "two: one, two, well done green balls, you are in your wagon". Thus, the colored balls counted on the stage get into the numbered wagons. For example, two balls get into the two wagon.

Figure 4. 3rd Video Image and Video Content.

Another video presented with accurate mathematical content is "How about counting with 1, 2, 3, 4, 5?" (10th video). The flow of the video is similar to 10th video (the five little ducks) in terms of the harmony of the visuals and the lyrics of the song.

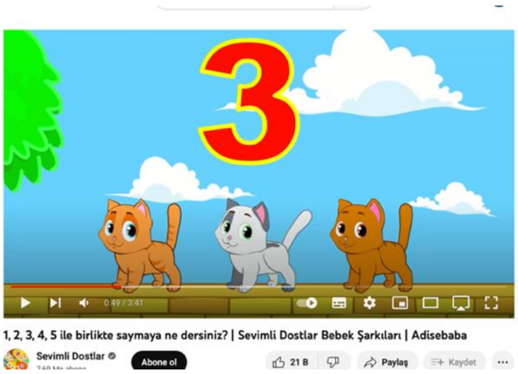
Video Image	**Video Image and Lyrics**
	In the video, the cats are on the wall and the cats on the wall are counted backwards according to the number sung in the song. The lyrics of the song are as follows: Five cats on the wall, five cats on the wall One came down from the wall, left four cats Five cats on the wall, five cats on the wall, Two of them came down from the wall, left three cats…

Figure 5. 10th Video Image and Video Content.

In the video above (10th video) cats are on a wall. In this video content, first a song was prepared for the cats to come down from the wall in order, and when each cat came down from the wall, the remaining amount was counted backwards and given in an accurate representation. At the beginning of the song, five cats appear on the wall. At each scene transition, a cat descends from the wall and the number of cats left is verbalized and emphasized in writing. As can be seen from the related visual, the number of cats in the visual is consistent with the number sung. In the continuation of the video, the same content is presented over the sparrow. However, there are some display errors in this video. These errors are mentioned in the headings below.

When all videos are watched, these three videos (2nd, 3rd, 10th) are the most mathematically correct videos. All visuals and voice-overs are consistent throughout the entire video and numbers are correctly represented as symbols. However, the other videos in this category (1st, 7th, 12th and 14th) have incorrect representations in different situations. In this respect, in order to avoid repetition, these videos are not included here because they are presented under the themes and codes below.

Mathematical representations. In the second part of the presentation of the findings of the study, the contents of the videos were analyzed in terms of the representations used in the presentation of mathematical content. Misrepresentations were observed while presenting the content of these videos. These elements were categorized under the following codes. These codes are: "*Using Symbols Only (1)*", *"Representing Nominals as Multi-Digit Numbers"(2)*, *"cardinal numbers are* *shown as ordinal numbers"(3), "mismatch between the number of objects displayed and the cardinal numbers"(4), "failure to count the of quantity"(5).*

Using symbols (nominals) only. In six videos (5th , 7th , 9th , 11th , 13th , 15th), object quantities that can be associated with numbers were not included, but numbers were visualized as symbols and used in this way. The general purpose of these videos may be to teach the consecutive repetition of numbers or the reading of number symbols. Examples of these videos are given below.

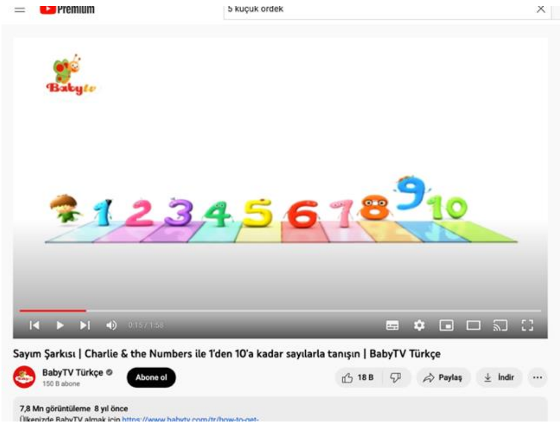
Video Images	Explanation about Images
	*9th video: Learning numbers with Hodo.* In this video, the train arrives at the stops in order The numbers are loaded into the wagon one by one. In this video, the train introduces the number by saying "look guys, this is the second of the two numbers we are looking for".
	*11th video: Turkish Numbers from 1 to 20* In this video, only the numbers are displayed in order. The incoming number is read.
	*13th Video: Pepee Number Song* In this video Pepee and Shila sing a rhyming song together. "1, 2, 3, 4, 5, Choose a wife for yourself. 6, 7, 8, 9, 10, jump jump jump jump jump..."

Figure 6. Related Video Images and Contents.

As can be seen in the examples in the videos above, the video content is geared towards the skill of reading numbers. In this demonstration, only reading is done in the video, similar to letter teaching. In all of the videos under this code, only symbols were included. In these videos, no demonstration was made to determine the amount of multiplicity, which is the main purpose of counting.

Representing nominals as multi-digit numbers. When the video content is watched, a frequently used way of representation in the videos
(1^{st}, 5^{th}, 7^{th}, 8^{th}, 9^{th}, 10^{th}, 13^{th}, 14^{th}, 15^{th}) is to write all the digits and/or numbers side by side as if showing a multi-digit number. The images below are taken from the relevant videos.

Video Images **Explanation about Images**



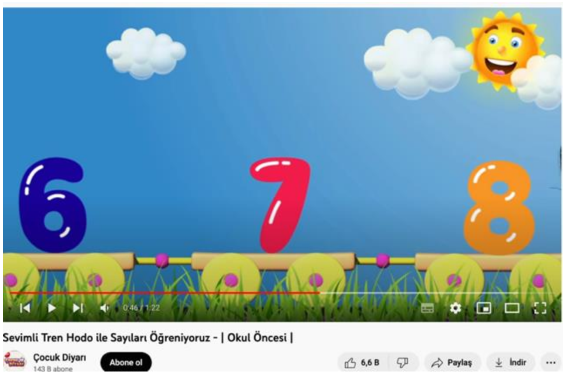
7th Video: Counting Song (0: 15)

In the video, all numbers are presented together as a whole, as an eleven-digit number.

14th Video: Learning Numbers With Cute Friends

(0:38 sn)

In this representation, the numbers 1,2,3,4 are given such as the number one thousand two hundred and thirty four (1234)



15th Video: Learning Numbers with cute train Hodo. (0:46)

In this video, he counts the numbers one by one. However, for example, as seen in the image, while the number seven is shown, other numbers continue to appear on the screen.

Figure 7. Related Video Images and Contents.

The notation given in these examples is seen in many videos. Mathematically, the main reason for writing the digits side by side is that the digits represent different magnitudes in different digits and together represent a magnitude as a whole. In these representation examples (in nine videos), it was observed that the nominal numbers were shown as representations of large-digit numbers and all numbers were written side by side. In these visuals, all numbers are shown as if they were a single multi-digit number.

Representing cardinal numbers as ordinal numbers. Another noteworthy misrepresentation in the video content is the representation of cardinal numbers as ordinal numbers. This representation is present in all videos (1st, 4th, 6th, 8th, 10th, 11th, 14th) that count by showing the whole objects with consecutive numbers. Some examples are given below.

Video Images	**Explanation about Images**
	14th Video: *Learning Numbers with Cute Friends.* In this video, numbers appears on each car. The numbers are used like the ordinal numbers. They do not represent the quantity of objects.
	10th Video: *How about counting with 1,2,3,4,5?* In this video, the symbols of the numbers appear one by one on each object in a similar representation like as ordinal numbers.

Figure 8. Related Video Images and Explanations.

In the videos, a single object is always pointed at and a number appears on it, even though a dot is not placed next to it to indicate "pearl". From this point of view, one number appears on the screen for each object. The most obvious error in this representation is the use of counting numbers as ordinal numbers. In this representation, each object of the counted set is paired with a number.

Mismatch Between the Number of Objects Displayed and The Cardinal Numbers. In the analysed videos, it can be considered as one of the noteworthy demonstrations. It is a notation used in consecutive counting videos. The notation used in two different ways is collected under this code. In the first case, as the objects in the videos flow through the screen one by one, different numbers appear on the screen simultaneously. Examples of videos using this representation are given below.

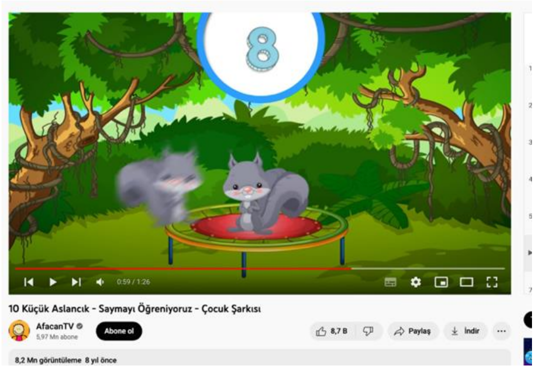
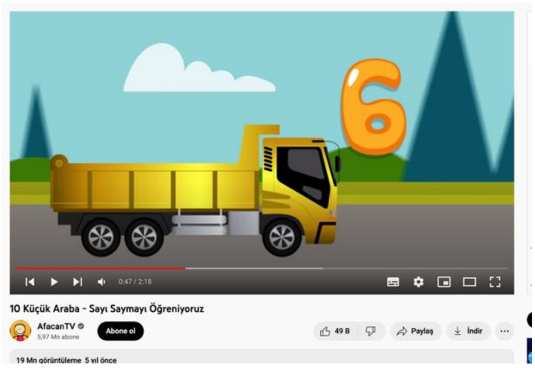
Video Images	**Explanation about Images**
	6th Video : 10 Little Lion In the lion video, the number eight is written while two animals appear on the screen. Throughout the video, an animal comes and goes from different places on the screen. When these animals appear, the counter on the screen runs.
	4th Video: 10 little car. A similar video by the same creator is about vehicles. These vehicles are shown moving quickly from right to left as if they were moving on a road. In the car video, as in the lioness video, a single object appears on the screen, while the number changes.

Figure 9. Related Video Images and Explanations.

In these videos, each time an object is seen, a counting number is given. In this representation, while the objects on the screen are constantly changing, the numbers also change like a counter display. However, it is not possible to match the number with the multiplicity or size of the object in this visual. For example, in the "lioness" video, while there is only one lion on the screen, the number eight is seen. In the second image, in the "10 small cars" video, the number six is given even though there is only one truck on the screen. In such a representation, there is an inconsistency between the number and the object seen. In such a representation, since there is no visualization of the number of objects in the set, the meaning of the magnitude of the numbers disappears. Below is the content related to the "five finger video" (video 12), which is coded under this code but as a different example.

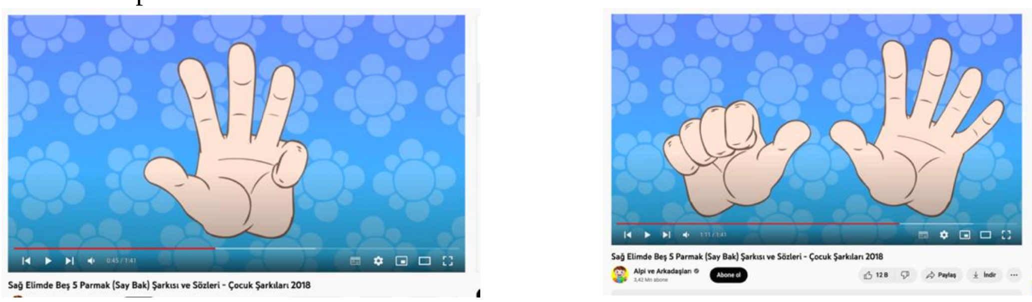


Figure 10. Video Image from 12th Video(Five fingers on my right hand*).*

The song in this video is an old preschool song. In this song, the creator shows the counting fingers in order with a simple visual. No symbols of numbers are used, but verbal counting is done with each finger. In one part of the song, the sixth finger is counted again like the first finger. While six fingers are visible in the visual (visual 2), the lyrics of the song start the counting from the beginning by counting "one, two, three..." again. While there are six fingers in the visual, the verbal expression "one" is presented. Therefore, there is an inconsistency between the number of counting and the number of objects.

Failure to count the of quantity. Below this code is a single video (1st). In different scenes of the video, different numbers of objects are given, but only up to ten are counted in the whole video content. In this case, the multiplicity that appears in the first scene does not match the shape and/or number of objects counted.

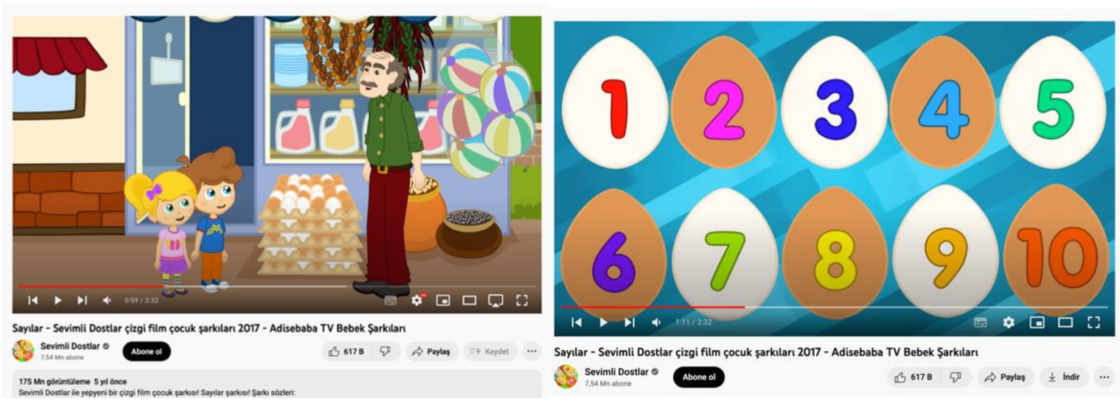


Figure 11. Video Image from 1st Video (Numbers, cute friends).

For example, in the video screenshot (Figure 11), children ask the grocer “how many eggs he has”. The grocer responds by saying "let's count them together". On the screen in the video image, five boxes of eggs are drawn very realistically. In the image, thirty eggs are shown in each egg carton, and since there are five cartons of eggs, it can be calculated that there are one hundred and fifty (150) eggs in the image. However, only up to ten of them are counted in the video. Throughout the video, objects such as balloons, flowers, watermelons, fish are shown in different quantities. However, the number of objects shown in the first scene is inconsistent with the number of objects counted. Below is another example from the same video.

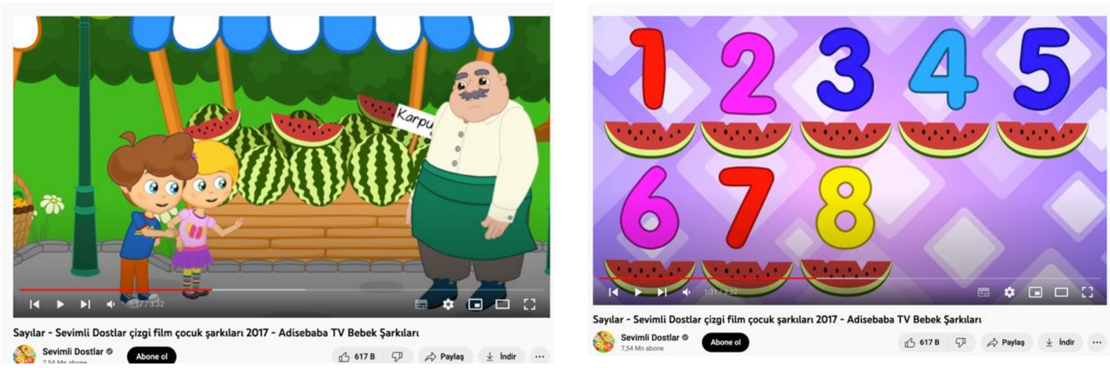


Figure 12. Video Image from 1st Video (Numbers, Cute Friends).

In the same video content, in the "watermelon" counting section, for example (Figure 12) as given above, a watermelon slice is counted after all watermelons are shown. It is seen that the counted objects are not consistent even in terms of shape. Similar negative example demonstrations are found throughout the video.

Figure 13.Video Image from 1st Video (Numbers, Cute Friends).

In this scene (figure 13), the fisherman is seen to have fish of different sizes and colours. Although there are thirty-one fish in the first scene, only ten of the small grey fish are counted. In this video, this is coded as "not counting the multiplicity shown".

Discussion, Conclusion and Recommendations

When the videos were analysed holistically, the content of the videos was categorized under three basic codes. The codes of the videos are "counting quantities, teaching consecutive counting numbers, teaching the reading of symbols of numbers". When these videos are examined, it is seen that the videos whose main purpose is "teaching consecutive counting numbers" repeat the numbers consecutively, and that the videos are created to memorize the counting order without attributing any meaning to counting. Although consecutive numbers were given verbally in these videos, no association with objects or multiplicities was used. In these videos, it does not seem possible for children to attribute the correct meaning to counting or to grasp the meaning of numbers as magnitude. This is because children begin to learn the concept of counting by comparing multiplicities (Sezer, 2008). Children construct the concept of number abstractly in their minds by seeing quantities of different numbers (between 1-10) together and visualizing them in their minds (Sarnecka & Carey, 2008).

According to the instructional purpose, 40% of the videos analysed were categorized under the code "teaching the reading of number symbols". It is seen that only symbols are used in these videos. Counting numbers is a different skill than memorizing a song or reading a letter (Olkun et al., 2013, Van de Walle et al., 2014). Trying to teach symbols under the name of number teaching and producing scenes using meaningless words instead of multiples may hinder children's number learning. The fact that preschool children can read the number seven does not mean that they can visualize the magnitude of the number seven in their minds or that they can establish the relationship between this number and other numbers. This is because this skill is a skill like literacy and is different from other skills related to counting (Van De Walle et al., 2014). From this point of view, the importance of concrete learning environments or concrete materials to support children's learning becomes more apparent, especially instead of presenting only symbol teaching videos to children.

When the videos are analysed in terms of instructional purpose, it can be said that the "counting quantities" videos are more understandable because the symbols and content are more consistent. However, the comprehensibility of the videos does not mean that their content is completely appropriate for mathematical representations. It can be said that only three videos out of the fifteen videos analysed were compatible in terms of both visual, mathematical and verbal content. In all the other videos (80%), there are inconsistencies between the representations and verbal expressions. However, what children see and what they hear should be exactly the same (Frye et al., 2013).

When the contents of the videos were analysed under the theme of "mathematical representations". In this theme there are five codes such as "using only symbols, showing numbers as a multi-digit number, using counting numbers as ordinal numbers, not matching the number of objects and counting numbers, not counting the multiplicity shown" were formed. The first code, "using only symbols", was used in six of the analysed videos (40%). This is a result of not associating the teaching of numbers with objects, that is, with "determining the amount of multiplicities", which is the main purpose of counting. However, the first stage of counting skill is the comparison of multiplicities (Reid, 2016). These video contents present counting verbally, regardless of multiplicities or quantities, only for literacy skills. In order for children to associate counting and numbers, they need to be presented with a concrete multiplicity (Van de Walle et al., 2014).

Another code under the theme of mathematical representations in the analysed videos is "using counting numbers as ordinal numbers". In the visuals in the videos, representations such as "ordinal numbers" were used on the counting objects. In the videos where each object is matched with a number, "the object matching the number 1 is no different from the object matching the number 7" in terms of representation. Children may have problems with this type of representations that they do not know the exact meaning (Frye, 2013). Children construct the concept of number abstractly in their minds by seeing and visualizing quantities of different numbers (between 1-10) together (Sarnecka & Carey, 2008). In addition, even before the introduction of technology into our lives (Treacy & Willis, 2003), studies have shown that five-year-old children have difficulty understanding that the last number spoken is the actual value of the number when counting a group of objects. When everything was more tangible, children had difficulties in understanding numbers and cardinality (Treacy & Willis,2003). In addition, research on linear representation of numbers shows that even if all children can count to ten, they cannot fully understand the quantity of the number (Reid, Baroody, Purpapa, 2015). In these videos, presenting a number with each object as an ordinal number may also make it difficult to understand the cardinal number and the quantity of multiplicity. Children who watch this video and do not know how to count may not be able to understand the quantity of multiplicity and the cardinal number principle. However, learning cardinal number principle is necessary for learning how to count (Sarnecka & Carey, 2008; Treacy & Willis, 2003).

In the videos analysed in this study, another code was "representing numbers as large-digit numbers". In the videos, it is seen that the numbers are written as a multi-digit number without leaving a space next to each other. These multi-digit numbers, which we see holistically, may prevent the individual reading and realization of numbers (digits) in number teaching. The use of this representation in many videos is striking. Nine out of fifteen videos (60%) used this representation. However, in preschool education, especially each number is introduced to children one by one (Van de Walle et al., 2014). The main reason for this is that these symbols are very complex for children who do not know numbers at all (Reid, Baroody, Purpapa, 2015). Writing these numbers together can be as complicated as writing a long sentence for an illiterate child.

Another code analysed in the demonstrations used in the videos is "the number of objects and the number of counting do not match". For children to perceive numbers correctly, they need to see these multiplicities holistically and hear the correct number (Reid, Baroody, Purpapa, 2015). In the videos coded under this code, the number of objects on the screen and the number of counting do not coincide. For example, in the "count look" video, six fingers are shown on the screen, while the counting number is one. However, even when watching a movie, if the audio and visuals are not synchronized in the video scene, we pause the video and make sure that what we see and what we hear are synchronized. Because the opposite is confusing. The mismatch between the number of objects seen and the number counted also contradicts the principles of counting, one-to-one correspondence, conservation, and cardinality. Children can count accurately when they understand the one-to-one mapping of each number to an object (Sarnecka & Carey, 2008; Treacy & Willis, 2003). The inconsistency between the number of objects and the number of counting objects in the videos may be an obstacle for children to learn counting correctly or may cause confusion in children.

Appropriate content needs to be presented appropriately for children to learn numbers because children's number sense in early childhood is a predictor of later mathematics achievement (Aubrey et al., 2006; Clements & Sarama, 2007). In first video; objects shown and objects counted are not consistent. Although this was observed in a single video, this code is considered to be important because it was the most watched video. This situation was coded as "not counting the multiplicity shown". For example, the quantity of watermelons at the watermelon stand was asked, but the watermelon slices were counted. In the content of this video, there are inconsistent situations like this (fish, eggs, cotton candy, balloons) in all scenes. These misrepresentations are not in accordance with the basic principles of counting (counting each object as a whole, "without dividing or fragmenting", one-to-one matching) (Frye et al., 2013).

The videos analysed in the research analyses are called educational videos. Parents are highly motivated to let their children watch these videos (Gözen et al., 2021). However, the presentation language of mathematics in these videos, which reach millions of views, is open to discussion. Even in content that can be considered innocent, there are errors, mistakes and content that can lead to difficulties in understanding mathematics. This content, which appears to be relatively less harmful than other videos as YouTube content, may be one of the obstacles in front of children's construction of conceptual knowledge rather than helping children learn. When it is seen that the videos are watched millions of times, it is understood how high the effect size of video content is. In this context, it can be suggested that families and teachers who use videos as preschool education content should be more careful and should not trust educational videos in YouTube content that contain many errors that are not noticed at first glance.

Although the video content generally has mathematically incorrect content, it would be more appropriate for parents and teachers to be selective because there are some videos with correct representations. This is because videos are good learning tools when they are well prepared, attract children's attention, teach while entertaining, and appeal to many senses (Neumann & Herodotou, 2020). Although most of the songs in the video content are beautiful, it may be difficult for children to understand when they are presented with poorly prepared and inaccurate visuals. In such cases, if these contents are to be used as a material, they can be presented to children only as songs, independent of visuals. In future studies, research can be conducted on how are children mental images who encounter a lot of video content.

About Author

First Author: Şeyma Şengil Akar is an. assistant professor at Kastamonu University, Faculty of Education, and Department of Elementary Education. Her doctoral desertion emphasis on Mathematics Education. Her academic interests are mathematics education, gifted education, mathematical modeling (MEA), mathematical creativity. She has articles, book chapters and presentations on these topics.

Conflict of Interest

As the author of the research, I declare that I do not have any interests or conflicts. The YouTube video content provider that I used during the research was chosen only because it is the most accessed or most used data provider. I, as the author, have no vested interest, institutional relationship or contact with YouTube. In addition, during the course of the research, in accordance with the purpose of the study, some video content from some children's education channels on YouTube was analyzed in detail. Most of these video contents were analyzed in terms of mathematical content and some of the videos were found to be adequate, some were found to be inadequate and poor. In this analysis and reporting process, completely scientific processes have been carried out and I, as the author, have no interest/conflict between me and these content providers.

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Ethical Standards

Since the method of this research is document analysis from open access sources, ethics committee permission was not obtained as there was no need for an ethics committee permission for the research. In the whole process from the planning of this research to its implementation, from data collection to data analysis, all the rules specified to be followed within the scope of the "Higher Education Institutions Scientific Research and Publication Ethics Directive" were followed. None of the actions specified under the second section of the Directive, "Actions Contrary to Scientific Research and Publication Ethics", have been carried out. In the writing process of this research, scientific, ethical and citation rules were followed; no falsification was made on the collected data. This study has not been sent to any other academic publication environment for evaluation.

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References

Alptekin, S. (2015). Sayma becerilerinin ögretimi. *Özel Egitim Dergisi, 16*(1), 63-74.

Akkaya, R. (2019). Sayılar, Sayma ve Sayı Kavramı. B. Durmaz (Ed.). *Erken Çocuklukta Matematik Eğitimi.* Pegem Akademi, Ankara.

Akman, B. (2002). Okul öncesi dönemde matematik. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 23*(23), 244-248.

Alat, Z. (2019). Kuramın Uygulamayla Buluşamadığı Yer: Erken Çocuklukta Matematik Eğitimi. *Adıyaman Üniversitesi Eğitim Fakültesi Dergisi, 9*(1), 1-20.

Aubrey, C., Godfrey, R., & Dahl, S. (2006). Early mathematics development and later achievement: Further evidence. *Mathematics Education Research Journal, 18*(1), 27–46.

Baroody, A. J., Eiland, M., & Thompson, B. (2009). Fostering at-risk preschoolers' number sense. *Early Education and Development*, *20*(1), 80-128.

Berch, D. B. (2005). Making sense of number sense: Implications for children with mathematical disabilities. *Journal of learning disabilities*, *38*(4), 333-339.

Bıkmaz Bilgen, Ö. & Doğan, N. (2017). Puanlayıcılar Arası Güvenirlik Belirleme Tekniklerinin Karşılaştırılması. Journal of Measurement and Evaluation in Education and Psychology, *8*(1), 63-78. DOI: 10.21031/epod.294847

Clements, D. H., & Samara, J. (2007). Early childhood mathematics learning. In F. K. Lester, Jr (Ed.), Second handbook on mathematics teaching and learning (pp. 461–555). Charlotte, NC: Information Age.

Erdoğan, S. Ç., & Baran, G. (2005). Erken Çocukluk Döneminde Matematik. *Eğitim ve Bilim*, *28*(130).

Frye, D., Baroody, A. J., Burchinal, M., Carver, S. M., Jordan, N. C., & McDowell, J. (2013). Teaching Math to Young Children. Educator's Practice Guide. What Works Clearinghouse. NCEE 2014-4005. *What works clearinghouse*.

Geary, D. C. (2015). Development and Measurement of Preschoolers' Quantitative Knowledge. *Mathematical Thinking and Learning*, *17*(2-3), 237–243

Gözen, G., Karakaş, N., Şahin, C., Özpoyraz, E., Altundal, M. N., & Acar, İ. H.(2021). Erken Çocuklukta Teknolojik Cihazlar Aracılığı İle Öğrenme. Özyeğin Üniversitesi Çocuk Gelişimi ve Öğrenme Çalışmaları Laboratuvarı Online Rapor ve Yayınları. (labs.ozyegin.edu.tr/cdll adresinden 10.10.2022 tarihinde indirilmiştir.)

Gülmez, E. (2019). *Okul Öncesi Dönem Kavram Öğretiminde YouTube'un Bir Eğitim Teknolojisi Olarak Kullanılması* (Yayımlanmamış Doktora Tezi), Necmettin Erbakan Universitesi.

Hannula, M., Räsänen, P., Lehtinen, E. (2007). Development of Counting Skills: Role of Spontaneous Focusing on Numerosity and Subitizing-Based Enumeration, Mathematical Thinking and Learning, *9*(1), 51-57, DOI: 10.1080/10986060709336605

Heintz, K. E., & Wartella, E. A. (2012). Young children's learning from screen media. *Communication Research Trends*, *31*(3), 22.

Hourcade, J. P., Mascher, S. L., Wu, D., & Pantoja, L. (2015, April). Look, My Baby İs Using An İpad! An Analysis Of YouTube Videos Of İnfants And Toddlers Using Tablets. In *Proceedings Of The 33rd Annual ACM Conference On Human Factors İn Computing Systems,* 1915-1924.

Karasar, N. (2005). Bilimsel araştırma yöntemleri. Nobel Yayımcılık. Ankara.

Kayhan Altay, M. (2010). İlköğretim İkinci Kademe Öğrencilerinin Sayı Duyularının; Sınıf Düzeyine, Cinsiyete Ve Sayı Duyusu Bileşenlerine Göre İncelenmesi. *Yayınlanmamış Doktora Tezi, Hacettepe Üniversitesi, Ankara*.

Kilpatrick, J., Swafford, J. & Findell, B. (Eds.) (2001). *Adding it up: Helping children learn mathematics*. Washington, DC: National Academy Press.

Lipton, J. S. ve Spelke, E. S. (2003). Origins of number sense: Large-number discrimination in human infants. *Psychological Science*, *14*(5), 396–401.

Merriam, S. (2009). Nitel Araştırma: Desen ve Uygulama İçin Bir Rehber (S. Turan, Çev. Ed.) Nobel Yayınevi: Ankara. *Orijinal basım yılı*.

Mulyana, F. A. P., Nandiyanto, A. B. D., & Kurniawan, T. (2022). E-Learning Media For The Ability To Recognize And Count Numbers İn Kindergarten Students. *International Journal Of Research And Applied Technology (INJURATECH)*, *2*(1), 151-157.

Nansen, B., & Jayemanne, D. (2016). Infants, İnterfaces, And İntermediation: Digital Parenting And The Production Of "İpad Baby" Videos On YouTube. *Journal Of Broadcasting & Electronic Media*, *60*(4), 587-603.

National Council of Teachers of Mathematics (NCTM) (1998). Curriculum and evaluation standards for school mathematics. Reston, VA: NCTM.

Neumann, M. M., & Herodotou, C. (2020). Young Children And YouTube: A Global Phenomenon. *Childhood Education*, *96*(4), 72-77.

Olkun, S., & Uçar, Z. T. (2009). İlköğretimde etkinlik temelli matematik öğretimi. Eğiten Kitap. Ankara.

Olkun, S., Fidan, E. & Babacan-Özer, A. (2013). 5-7 yas çocuklarda sayi kavraminin gelisimi ve saymanin problem çözmede kullanımı. *Egitim ve Bilim*, 38(169), 236-248.

Puspita, B. B., & Edvra, P. A (2022). The Use Of YouTube And Apps By Digital Moms To Support Early Childhood Learning. *Athens Journal of Mass Media and Communications* *8*(4), 237-256.

Reid, K. (2016). Counting on it: Early numeracy development and the preschool child. *Australian Council for Educational Research* (ACER). https://research.acer.edu.au/learning_processes/19

Reid, E. E., Baroody, A. J., & Purpura, D. J. (2015). Assessing young children's number magnitude representation: A comparison between novel and conventional tasks. *Journal of Cognition and Development*, *16*(5), 759-779.

Reys, R., Reys, B., McIntosh, A., Emanuelsson, G., Johansson, B., ve Yang, D. C. (1999). Assessing number sense of Students in Australia, Sweden, Taiwan, and the United States. *School Science and Mathematics*, *99*(2), 61–70

Sarnecka, B. W., & Carey, S. (2008). How counting represents number: What children must learn and when they learn it. *Cognition*, *108*(3), 662-674.

Sarnecka, B. W., & Lee, M. D. (2009). Levels of number knowledge during early childhood. *Journal of experimental child psychology*, *103*(3), 325-337.

Sezer, T. (2008). Okul öncesi eğitimi alan 5 yaş grubu çocuklara sayı ve işlem kavramlarını kazandırmada drama yönteminin etkisinin incelenmesi. (Yayımlanmamış Yükseklisans Tezi). Abant İzzet Baysal Üniversitesi Sosyal Bilimler Enstitüsü, Bolu.

Taşkın, N. (2019). Küçük Çocuklarda Sayı Kavramı. B. Akman (Ed.). *Erken Çocuklukta Matematik Eğitimi.* Pegem Akademi. Ankara.

Treacy, K., & Willis, S. G. (2003). A model of early number development. In L. Bragg, C. Campbell, G. Herbert, & J. Mousley (Eds.), Mathematics Education Research: Innovation, Networking, Opportunity: *Proceedings of the 26th Annual Conference of the Mathematics Education Research Group of Australasia* (Vol. 1, pp. 674 - 681). Deakin University

Veziroğlu Çelik, M., Acar, İ. H., Bilikci, C. A., Şahap, G., & Yalvaç, B. M. (2018). Çocuk, Teknoloji ve Medya: Okul Öncesi Ve Sınıf Öğretmenlerinin Görüşleri Üzerine Bir Çalışma. *Turkish Studies (Elektronik)*.

Yıldırım, A & Şimşek, H. (2005) Sosyal Bilimlerde Nitel Araştırma Yöntemleri Güncelleştirilmiş Geliştirilmiş 5. Baskı, Ankara: Seçkin Yayıncılık.

Van De Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2014). İlkokul ve ortaokul matematiği: gelişimsel yaklaşımla öğretim. Nobel Akademik Yayıncılık.