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Video Production About Area and Perimeter by Grade 7 Elementary School Students

Maicon Quevedo Fontela [a]
João Carlos Pereira de Moraes [b]

[a] Universidade Federal do Pampa (Unipampa), Programa de Pós-Graduação em Educação, Jaguarão, RS, Brasil.
[b] Universidade Tecnológica Federal do Paraná (UTFPR), Departamento de Educação, Curitiba, PR, Brasil.

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ABSTRACT

Context: Although the use of video has been consolidated as a growing proposal in the classroom, there is no evidence of studies emphasising video production to construct mathematical knowledge of area and perimeter in basic education.. **Objective**: Analysing the contributions of the creation of videos by Powtoon in addressing areas and perimeters to the education of Grade 7 students at an elementary school in the countryside of São Borja, RS, Brazil. **Design**: An action research proposal is developed. **Setting and participants**: Six Grade 7 students from a rural school in São Borja/RS, Brazil. **Collection and analysis:** The research steps were 1) Application of a questionnaire; 2) Creation of the videos in four moments: a) Conversation with the students and presentation of the proposal, b) Research on the topic, c) Creation and finalisation of the videos, and d) Dissemination of videos; 3) Individual conversation about the answers in the beginning survey. Data analysis was based on content analysis. **Results**: The following are listed: 1) Visualising the understanding and development of students in relation to the concepts of area and perimeters; and 2) Technology, video and mathematics education, discussion of how students relate to technology and video in the classroom. **Conclusion**: Students employed effort in creating the videos and elaborated more deepened comprehensions on areas and perimeters. However, it should be noted that the students' video production is associated with the traditional class model, leading us to question how the classes have been organised in basic education.

Keywords: Video; Area and perimeter; Technology.

Corresponding author: João Carlos Pereira de Moraes. E-mail: joaomoraes@utfpr.edu.br

A Produção de Vídeos sobre Área e Perímetro por alunos do 7º ano do Ensino Fundamental

RESUMO

Contexto: A pesquisa emerge das necessidades formativas dos alunos quanto ao conceito de área e perímetro e o interesse na produção de vídeos. **Objetivo**: Analisar as contribuições da criação de vídeos pelo *Powtoon* no trabalho com área e perímetro para estudantes do 7º ano do Ensino Fundamental de uma escola de educação do campo de São Borja/RS. ***Design***: Desenvolve-se uma proposta de pesquisa-ação. **Ambiente e participantes**: Seis alunos de uma escola do campo em São Borja/RS, que formam a turma de 7º ano. **Coleta e análise de dados**: As etapas da pesquisa foram: 1) Aplicação de um questionário; 2) Criação dos vídeos, em quatro momentos: a) Conversa com os alunos e apresentação da proposta, b) Pesquisa sobre o tema, c) Criação e finalização dos vídeos, e d) Divulgação dos vídeos; 3) Conversa individual sobre as respostas obtidas no questionário inicial. A análise de dados pautou-se na análise de conteúdo. **Resultados**: Elencam-se: 1) Conceito de área e perímetro, em que se visualiza os entendimentos e desenvolvimento dos alunos em relação ao tema; e 2) Tecnologia, Vídeo e Educação Matemática, discussão de como os discentes se relacionam com a tecnologia e com o vídeo em sala de aula. **Conclusões**: Percebe-se que os alunos apresentam empenho na produção de vídeo e elaboraram compreensões mais aprofundadas sobre área e perímetro. No entanto, nota-se que a concepção de produção de vídeo dos alunos está associada ao modelo de aula tradicional, o que permite questionar o modo como a aula tem sido organizada na Educação Básica.

Palavras-Chave: Vídeo; Área e Perímetro; Tecnologia.

INTRODUCTION

Until the 1960s–70s, mathematics teaching was centred on abstractions, focusing more on theory than practice (Oliveira, Silva & Valente, 2011). From problematising the implications of this element for the mathematics teaching-learning process, some alternative proposals for pedagogical action emerged, configuring trends in mathematics education (Zorzan, 2007; Fiorentini, 2008).

Among the alternative practices, video use has been a growing trend in the classroom (Oechsler, 2015). However, according to Fontela and Moraes (2021), there is no evidence of studies emphasising video production to construct mathematical knowledge of area and perimeter in basic education.

In this sense, this study sought to emphasise this gap, aiming to analyse the contributions of the creation of videos by *Powtoon* in work with area and

perimeter with students of the 7th grade of an elementary field education school in São Borja, RS, Brazil.

VIDEO

The use of digital technologies has occupied a significant space in our society in recent years. Those resources have become essential tools in organising our routines, especially nowadays, when virtual resources are fundamental for maintaining our social, educational, and professional lives.[1] Amid those situations, we realise how important technologies are for the development of routine practices.

Virtualisation is present in all spaces, allowing access to information at any time, and making us rethink our classroom practices. This reality guides us to understand the interactions and transformations occurring in society to enhance our pedagogical practices in the educational area. Regarding virtualisation, Borges (2000) points out that technological means allow a process of interpretation, interconnection, and complementarity, promoting acts of creation and invention.

In this context, digital video use is increasingly present in our daily lives. From them, we access information, enjoy ourselves, and interact with what is happening in digital media. From those potentialities that occur with technologies, it is possible to create new relationships in obtaining new knowledge and develop new ways of learning and thinking.

Thus, we consider that video allows aspects from entertainment to learning, since concepts can be explored in a different way. Those who produce videos end up 'playing' with special effects, inserting images, sounds, and virtual objects. In other words, exercising imagination and invention is possible (Borba, Chiari & Almeida, 2018).

Moran (1993) points out that videos are

> […] sensory, visual, spoken language, and musical and written language. Languages that interact superimposed, interconnected, and added instead of separated. Hence their

It is noteworthy that we intended to video and audio record the group. However, this was not done because the students felt shy when they realised the presence of the camcorder.

> strength. They hit us in every sense and way. The video seduces us, informs, entertains, and projects in other realities (in the imagination) and other times and spaces. (Moran, 1993, p. 2)

In a similar sense, according to Borba, Scucuglia, and Gadanidis (2014, p.30),

> Digital videos, which can be conceived as narratives or multimodal texts, compile various modes of communication such as orality, writing, dynamic images, spaces, forms of gesture, movements, etc., integrated with the use of different technologies, such as chalk and blackboard, GeoGebra, digital camera, and notebooks, among others.

In this way, video can contribute to learning dynamically with access to understandings of experiences that they may not have had in the traditional teaching model. Thus, we want video not only to be a means of communication but also an instrument capable of providing new knowledge. Or, as Ferrés (1996, p. 70) states,

> The video-based didactic programme can be simply a means of information. It often is. However, it can also become an excellent instrument for the students to learn how to formulate questions, to learn to express themselves, so that they learn to learn.

In this sense, by combining the use of technologies, the creation of videos, the students' daily lives, and school concepts, we foster the interaction between the students' daily knowledge and the new concepts to learn.

This idea is reinforced by Faria (2001), who considers that video technology in the classroom allows "a more creative, autonomous, collaborative, and interactive teaching and learning" (Faria, 2001, p. 64). Thus, the videos go from image transmitters to possibilities in the construction of knowledge.

METHODOLOGY

As for the method approach, this research is qualitative, since the data collected are predominantly descriptive, and we are more focused on the process than on generating a product (Ludke & André, 1986). In this sense, our concerns are more related to the meaning and interactions that the research

subjects produce for the concept of area and perimeter through Powtoon software video creation than to the numerical stipulation of results.

About the means for conducting the research, this study is inspired by action research. According to Thiollent (2003, p. 24), action research

> [...] it is a type of empirically-based social study conceived and carried out in close association with an action or with the resolution of a collective problem, in which researchers and participants, representatives of the situation or problem, are involved in a cooperative and participatory way. (Thiollent, 2003, p. 24)

This process is based on a cyclical sequence, in which: we identify a problem arising from the reality of the field of research, in this case, the learning of area and perimeter; then, we elaborate an intervention plan; after that, we apply the plan and produce the data; and, finally, we evaluate the process of action.

Regarding the research field, this study was conducted in a 7th-grade class composed of six students aged 13 on average. The school is in a rural location. Most students live far, so there is school transportation to facilitate their daily commuting. The subjects were five girls and one boy who had studied together since Grade 1, so we noticed they enjoyed a good friendship without conflict. The class was very participatory and creative.

We omitted the subjects' names to maintain their anonymity. Instead, each research participant chose a fictitious name for her/himself, which could be neither the name chosen by other participants nor their real names.

The videos were produced in pairs, and each chose the name of their video production company. The names chosen for the companies were:

- *AgroMatemática*: composed of Aly and Gra.
- *Produções MN*: composed of Nani and Taty.
- *TEC Produções*: composed of Vine and Sophia.

Instruments and procedures:

Data production began with a questionnaire aimed at considering the students' social perceptions of area and perimeter, which were discussed at the end of the intervention process.

The students took their questionnaires to answer at home. The researcher explained that they should answer the questions without consultation. Moreover, they told students that the questionnaire did not score as an assignment and would not be corrected in the collective.

Data were also produced from the observations and written registers during the meetings for the creation of the videos in the Powtoon software.[2] To record this stage, I used photographs and the activities the group carried out.[3] Besides these register mechanisms, I produced a field diary, presenting a descriptive-analytical account of the routine along the activity.

The research followed the ethical recommendations involving human beings, approved by the Research Ethics Committee to safeguard the participants' rights.[4] Thus, only students who agreed by signing the Informed Consent Form (TALE) participated in the research, with the consent of their guardians, who signed the Informed Consent Form (TCLE).

Along with the initial questionnaire, the intervention used the Powtoon software and video production steps, inspired by Oechsler, Fontes, and Borba (2017), as detailed below.

1st – Conversation with students and presentation of the proposal

For the creation of the video, we showed the students videos addressing mathematics education and presented them with the software they would use. In this way, they watched animations with mathematical content produced by other students to serve as ideas for their future productions. After the program tutorial was displayed, we presented the software to show the available resources and their potential.

[2]PowToon is a cloud-based software that makes it possible to create animated presentations. Since February 2013, PowToon has introduced the option of a free account, which allows users to create videos. These videos can be exported to YouTube for free.

[3]It is noteworthy that the intentions were to make audio and video recordings of the group, but they were not used, since the students expressed shame when they perceived the insertion of the recorder and camcorder.

[4]The project was approved by number 4.610.378.

2nd – Research on the subject

At this stage, the students searched the internet about the mathematical theme of the video, looking for definitions, examples, and images to organise their productions. At this stage, the students also organised the video format, i.e., chose the descriptions of the mathematical concept, images, characters, objects, sounds, etc.

3rd – Creating and finishing the videos

At this stage, they organised the video production, inserting the materials selected in the previous step to detail the information that would be inserted in the video scenes. Students could use support materials, for example, mobile phones, recorders, or other electronic devices, if they wanted to complement the video with some other tool.

Then, they finished the video and had all the necessary support for any questions they might have during the creation of the video until its exportation to YouTube.

4th – Video disclosure

After the videos were edited and finished, i.e., after the complete creation process, we exhibited them at the school, inviting management, teachers, staff in general, and the other classes.

Data analysis

To meet the demand for analysis, we used content analysis as an interpretation methodology. In this sense, we used induction and intuition processes as strategies to achieve deeper levels of understanding of the phenomenon we proposed to investigate.

Thus, based on two specific objectives of our research, we elaborated two a priori categories (Table 1)

Table 1

A priori categories

Specific objective	Category
To investigate the construction of the concepts area and perimeter by 7th graders of elementary school in the intervention process.	Concept of area and perimeter
Explain evidence about the relationship of 7th-grade students with technology during the intervention process.	Technology, video, and mathematics education

However, these categories are not given. Regarding the stages of execution of content analysis, we can highlight that the steps allow the researcher to define and classify the units of meaning and, thus, unveil new and often unexpected meanings of the document.

To present the data, we used the procedures listed in Table 2.

Table 2

Presentation of instruments

Instrument	Presentation in the text
Initial questionnaire with students	Presented by the acronym QI, associated with the responding student. Example: Answer of the student Marcos: QI-Marcos
Field diary prepared by the researcher	Presented by the acronym DC, associated with the day of the intervention to which it refers. Example: Field diary of November 26: DC-26/11.
Students' or group's annotated speeches	Presented by the student's or group's fictitious names in bold before speaking. Example: **Marcos**: I like math
Individual conversation about the questionnaire	Presented by the letter CO, associated with the student's fictitious name. Example: Conversation about the questionnaire with Marcos: CO-Marcos.

RESULTS AND ANALYSES

Category 1: concept of area and perimeter

For the composition of this category, we sought to respond to the following specific objective of the research, i.e., to investigate the construction of the concepts of area and perimeter by 7th-grade elementary school students during the intervention. In this research context, we list the following elements: 1) *knowledge as a school and daily process*; 2) *conceptual network on area and perimeter*; 3) *presentation of the concept of area and perimeter,* and 4) *conceptual modification*.

In the first element, knowledge as a school and daily process, we point out the need to think about the area and perimeter teaching from the perspective of a spiral curriculum (Moraes, 2018; Bruner, 1973). This idea starts from the assumptions that students live experiences with the concept of area and perimeter since the early years of elementary school, which deepen as they progress. Or, as Bruner (1973, p. 12) points out, "as it develops, a curriculum must repeatedly return to those basic ideas, elaborating and reworking them, until the student has fully captured their complete systematic formulation".

However, students report never having studied the subject or not remembering it. For example, when asked: "Have you heard about area and perimeter?" their answers were:

> ***Aly****: Yes, I've heard of it, but I've never studied [it].*
>
> ***Sophia****: By reading books, I learned that perimeter is a line that closes a figure, and area is the result of multiplying the width by the length.*
>
> ***Vine****: I don't remember hearing about it.*
>
> ***Nani****: I haven't heard [about it].*

Still, we do not believe that students have never studied area and perimeter until the 7th grade of elementary school. As we can see in the previous skills provided by the BNCC. (Table 3)

Table 3

Area and Perimeter in the BNCC

School year	Skills
4th grade	(EF04MA21) Measure, compare, and estimate the area of flat figures drawn in grid mesh by counting the squares or squares halves, recognising that two figures with different shapes can have the same area measure.
5th grade	(EF05MA20) Conclude through investigations that figures of equal perimeters may have different areas and that, also, figures that have the same area may have different perimeters.
6th grade	(EF06MA29) Analyse and describe changes that occur in the perimeter and area of a square when expanding or reducing, equally, the measurements on its sides to understand that the perimeter is proportional to the measurement on the side, which does not occur with the area.

Thus, since the 4th grade, the curriculum contains the concepts of area and perimeter. We think, then, that the students' oblivion results from a non-organisation of the spiral curriculum as desirable, in which "the activities provide situations that encourage the student to reflect, conjecture, infer, estimate, demonstrate, prove, relate, analyse, and not just calculate, find, follow, observe, perform" (Silva & Pires, 2013, p. 255).

Associated with this idea, we also perceive the students' and family members' devaluation of everyday knowledge (of their knowledge) in the construction of mathematical knowledge. As we noticed in the two excerpts,

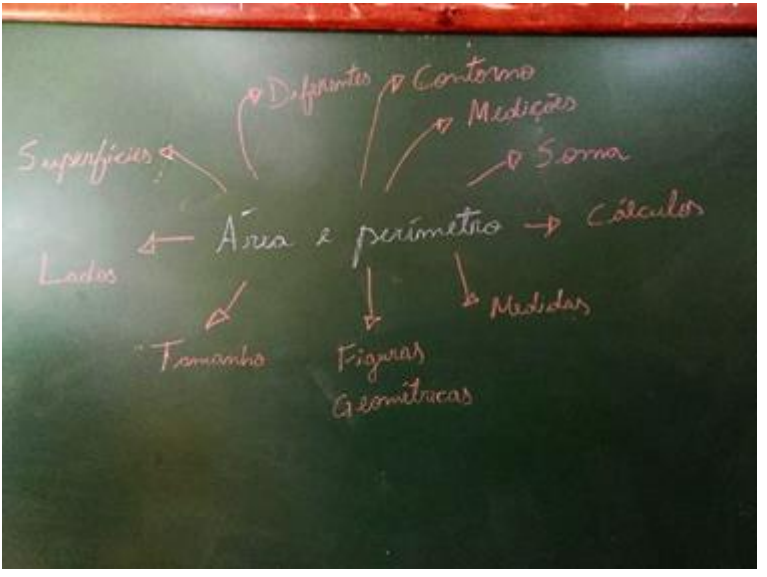
> Before we even talked about what the activity would be, some students said that *if* ***they don't know, parents shouldn't know either***. Thus, we emphasised that if they did not get any information from their parents, they could search websites about the area and the perimeter (DC- 30/09, emphasis added).
>
> ***Sophia****: I asked my father and mother, but they had no idea what it was.*
>
> *[...]*
>
> ***Vine****: I asked my uncle, but he said, "I only know the rural [concepts], not the urban".*

From the statements, we visualise that, for the group, there is *urban knowledge*, which is valid at school, and *rural knowledge*, which serves for everyday life only. According to Carraher, Carraher, and Schliemann (1995, p. 12), "learning mathematics at school would be the moment of interaction between formal mathematics –organised by the scientific community– and mathematics as a 'human activity'". Thus, "formal mathematics" should be in line with "everyday mathematics", which is related to everyday situations. However, in the subjects' speeches, we notice a divergence between those two relationships. The concept is understood from different conceptions and sometimes not understood at all during everyday activities.

The second element manifested in the category refers to the *conceptual network on area and perimeter*. This conceptual network was produced in the collective before the production of the videos, in the *Research on the theme* stage. The scheme was presented as described in Figure 1.

Figure 1

Conceptual network on area and perimeter



Regarding the category of conceptual network on area and perimeter, we brought the idea of a network of meanings as a form that approaches knowledge formation. To this end, Machado (2001, p. 25) defined that:

> The idea of a network is an emerging image for the representation of knowledge, inspired, in large part, by information technologies. From this perspective, knowing is like entangling, weaving meanings, sharing meanings. Meanings, in turn, are constructed through relationships established between objects, notions, and concepts. A meaning is like a bundle of relationships. The meaning of something is constructed by talking about the theme, establishing pertinent connections, sometimes unsuspected, between various themes. The bundles of relationships, in turn, are articulated in a large web of meanings and knowledge is a web of this type.

Thus, the network is constituted of a great web of meanings existing between the relations of the representations of knowledge. And some characteristics can be associated with the types of networks, such as acentrism, historicity, and heterogeneity, which are associated with the representation of knowledge. Machado (2001, p. 32) defines those characteristics as follows:

> **Acentrism**: The web of meanings that represents knowledge has no centre. Or the centre could be anywhere, which is tantamount to asserting the inexistence of an absolute centre.
>
> **Historicity**: [...] as an image of knowledge is the fact that they are in a permanent state of updating or their natural historicity.
>
> **Heterogeneity**: The image of the network continually reminds us that the nodes/meanings are naturally heterogeneous, in the sense that they involve relationships belonging to multiple contents, to several disciplines.

Such characteristics are fundamental for the articulation between knowledge and its possible meanings through the network mapping process.

Within this context, we point out some relationships that students have built in the process that may be associated with the concepts discussed in the study:

- Area as **calculation/measuring/measure/ surface** size of a **geometric figure** from the multiplication of the **sides**.

- Perimeter as **calculation/measuring/measure/size** of the **geometric figure contour** from the **sum** of the **sides**.

This is the researchers' reconstruction of the concept in an attempt to signify possible relationships that students have produced. However, we cannot ensure that these were the constructions produced; what we can list is that students related mathematical objects (geometric figure), the measuring action (calculation/measuring/measure/size/sum), and elements of the geometric figure (side/surface).

The third element listed in this category refers to the students' process *of presentation of the concept of area and perimeter.* In this context, the students used three strategies to present the concept of area and perimeter: *definition, representations, and social uses*.

In the *definition*, students emphasised what an area and a perimeter are. Thus, in the videos produced, all students chose to present a written slide with what they understand by area and perimeter (Table 4).

Table 4

Definition of groups

Definition and group	Understanding of researchers
 Grupo *TEC Produções*	This group's definition was based on the association of what the area calculates (surface) and how the perimeter is calculated (sum of the sides).

Grupo *AGRO Matemática*

This group's definition emphasised the source object of the measure. Both area and perimeter are useful for measuring the geometric figure.

Grupo *Criações MN*

This group's definition was based on the association of what the area calculates (surface) and how the perimeter is calculated (sum of the sides).

By the definitions, we register that even wanting to bring formalised definitions of area and perimeter, students use other resources to say what an area and a perimeter are, such as calculation mode and objects they calculate.

If we return to Macedo (2006), cited in the theoretical framework of this report, we would remember that "the area of a polygon is the extension of

a limited portion of the surface occupied by any closed polygon" and "the perimeter comprises the extension of all sides of any closed polygon, the numerical value corresponding to its contour" (Macedo, 2006, p. 76).

However, for the students' productions, we agree with Moraes (2018). For that author, the students' production of definitions of mathematical concepts is not an easy process, and its formality is not always a guarantee of their correct applications. Thus, we consider that students' manifestations of understanding (how to calculate and what to calculate) are as pertinent to the learning process as they are to define the concept.

Regarding the *representations to explain the concept*, we highlight the use of the following representations:

- Numerical representation: represents the concept, relying on numerical data;
- Written representation: represents the concept, relying on writing;
- Image representation: represents the concept, relying on images;
- Combined representation: represents the concept, relying on two or more of the previous representations.

Those representations are shown in Figure 2.

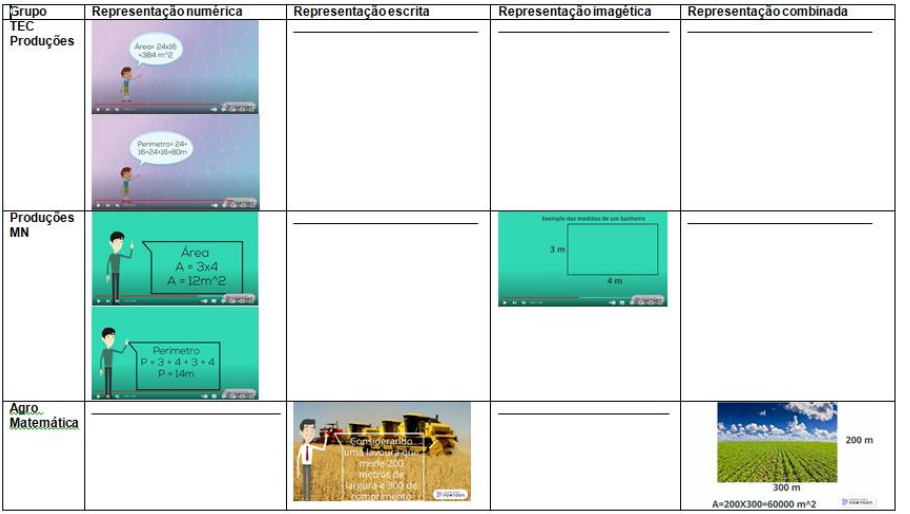
According to Colombo, Flores, and Moretti (2008), supported by Duval's theory of registers of semiotic representation, the mathematical object should not be confused with its representation. In this sense, representations can be said to be ways of presenting the concepts of area and perimeter but not the concept itself. However, without them, we would not know such concepts.

In addition, the authors note that

> [...] it is only possible to know, understand, learn mathematics through semiotic representations of the mathematical object. And he goes further: the subject needs to mobilise such representations to truly know, i.e., to operate with them, to instantly "convert" a representation of the mathematical object, given in a semiotic system, into another representation of another semiotic system that is more cognitively economical to solve a given problem (Colombo, Flores & Moretti, 2008, p. 45).

Figure 2

Representations of the concept



In this sense, even if we do not delve into Duval's theory of registers of semiotic representation, we note that the video provoked the groups to seek to manifest more than one form of registration, except *TEC Produções*, which used only the numerical record. We also emphasise that the combined use (numerical and imagery) by AgroMatemática *brought* difficulties to the group, which ended up performing a more illustrative than representative image representation of the mathematical concept.

The last aspect of the students' presentation of the concepts is the *social uses* of area and perimeter. In this context, the students contextualised the concept of area and perimeter. According to Luccas and Batista (2008, p. 3), "contextualisation is the process of constructing the interrelationship of circumstances that accompany a fact or situation". So, we can say that the students presented circumstances of insertion of the concepts discussed.

The *AgroMatemática* group presented the crop as a space of contextualisation. The issue appeared in three moments:

- In the delivery and discussion of research on area and perimeter:

***Aly**: My mother and my brother helped me, they tried to explain [it] to me with examples of farming, then I wrote what they told me there, then I already have some ideas to make the video.*

- In the process of selecting the images:

  ***Researcher**: Why did you choose these images?*

  ***AgroMatemática** [showing a photo of agriculture]: because models are more used by agronomists, and that's what we want to do in our video.*

- In the video created (Figure 3).

Figure 3

Print of the AgroMatemática video

Produções MN, on the other hand, brought the contextualisation of mesuring a home space for the intervention. We chose two moments in which this contextualisation appears:

- In the process of selecting the images:

  ***Produções MN**: We will use photos of geometric figures and texts to explain the use of area and perimeter. In the examples, I want to see about the measurements, like the ones done in the houses.*

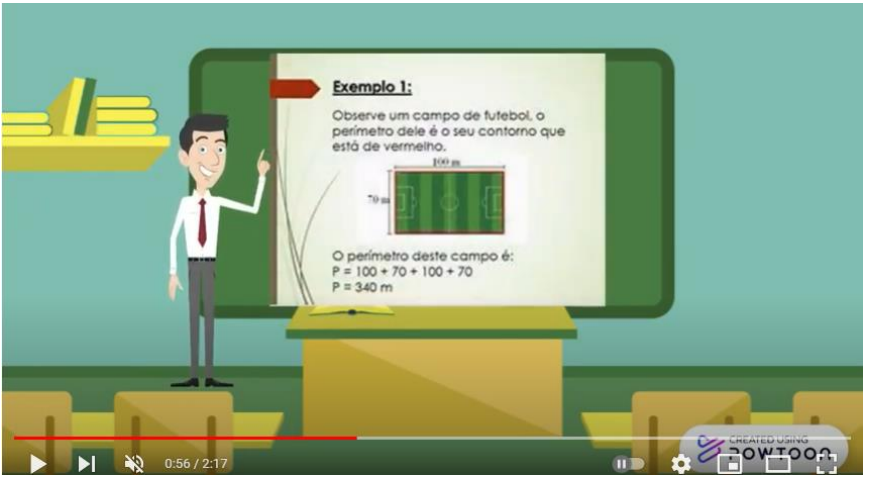
- In the video created (Figure 4).

Figure 4

Print of the Produções MN video

Figure 5

Print of the TEC Produções video



In turn, *TEC Produções* conducted a contextualisation process in the school court. However, we only saw this contextualisation in the video they produced (Figure 5).

Although it was not within the scope of this research, we could have had the mathematical concept with the groups transcend the contextualisation to reach the debate of broader social issues (D'Ambrosio et al., 2011). We pointed out this perspective because everyone brought questions into which to delve: the field, civil construction, and the school organisation.

The last element related to the concepts of area and perimeter is the evidence of *conceptual change*. To this end, we bring some notes present in the questionnaire and the final conversation with the students.

The changes related to the concept of area are listed in Table 5.

Table 5

Changes in the concept of area

Name	Questionnaire	The final conversation
Aly	Big field with no vegetation, just grass.	[I would explain] that the area is the inside of everything, that is, the inside of any surface.
Gra	I would explain with some text.	I would take a picture or a video to explain that the area is the measure of the surface.
Vine	I'd say it depends on what kind of area.	[I would explain] that the area are concepts [sic] used in geometry and to discover the area, you need to multiply the sides.
Taty	Area is perimeter used to determine the measurements of a figure.	Area is the measurement of a space, of a figure.
Sophia	In my thinking, area means a surface from somewhere.	That area is the multiplication of sides.
Nani	Well, the area, there are several ways [we] can explain it, but I was going to say that the area is a lot etc.	That the area is the space of a place or a figure.

As for the concept of perimeter, we list the following changes:

Table 6

Changes in the concept of perimeter

Name	Questionnaire	The final conversation
Aly	Asphalt, gas station, sidewalk.	It is the sum of the sides of a figure.
Gra	With some text.	With a video to say that perimeter is the sum of the contour of the figure.
Vini	I'd say I don't know what a perimeter is.	The sum of the size of the sides of a figure.
Taty	Perimeter to me is the time count.	Which is the sum of all the sides of a figure.
Sophia	I would say that perimeter is the line that closes a figure.	That it is the sum of all sides.
Nani	I don't even know what a perimeter is.	You measure the sides of a figure and then you sum them up.

Based on Baltar (1996), we noticed that some elements of a topological understanding of area and perimeter came into action and may indicate conceptual change.

We noted that, initially, the area was associated with non-generalisable elements – a *big field* (QI-Aly) or a *lot* (QI-Nani). After the intervention process, the area is said to be as *space* (CO-Taty/ CO-Nani), *surface* (CO-Gra), *inside of everything*, *the inside* (CO-
-Aly). Thus, we visualise a generalisation process, in which the concept of area becomes a possible application to other objects and contexts.

The same occurs with the concept of perimeter. At first, we list non-generalisable elements –*asphalt, gas station* (QI-Aly)–, *misunderstandings* — time counting (QI-Taty)— and ignorance of what it would be (QI-Vini/ QI-Nani). After the video productions, we visualised correct definitions. Students associated the measurement of contour (CO-Gra) and sides (CO-Aly/ CO-Vini/ CO-Taty/ CO-Sophia/ CO-Nani) with the perimeter.

From the elements organised in this stage, there were significant perceptible changes in the process of knowledge construction through different contextualisations to represent the concept of area and perimeter in the groups' productions. The notes listed present different perspectives from the initial ideas related to the questionnaire, in which they described them in the way they

understood them, and during the process, they explored elements of the concepts.

Category 2: Technology, Video, and Mathematics Education

The second category raised in the research emerges from the objective: to explain evidence about the relationship of 7th-graders with technology during the intervention process. Given the intentionality, the elements that emerged were: 1) *technology at school*; 2) *the image itself in the context of research with technology*; 3) *mastery (or not) of technology*; 4) *video and reproduction of traditional class*.

The first element we emphasised is *technology in school*. This is composed of two founding aspects: *technology and pandemic* and *internet access at school*. Both reflect the presence of public policies that relate technology to education.

Regarding *technology and pandemic*, like so many others, the school where the research was carried out suffered the impacts of education in times of social isolation. Given this moment, a *pandemic pedagogy* emerged (Barreto & Rocha, 2020), organised for the reality of the pandemic world.

In this context, the Opinion of the National Education Council proposes measures to remedy the difficulties imposed by the pandemic in the school environment:

- classes recorded on television, organised by the school according to the planning of classes and content or via digital platforms of the content organisation;
- evaluation system carried out at a distance under the guidance of schools and teachers and, where possible, with the supervision of parents about their children's learning;
- list of activities and exercises, didactic sequences, learning trails per complexity flow related to skills and learning objects;
- guidance to parents to carry out activities related to the learning objectives and skills of the curriculum proposal;
- guidance guides for parents and students on the organisation of daily routines;
- suggestions for parents to read for their children;

- use of open TV schedules to bring educational programmes compatible with children of this age and guide parents to what they can watch;
- preparation of printed materials compatible with the age of the child to carry out activities (reading, drawings, painting, cutting, folding, and glueing, among others);
- distribution of educational videos (short term) through online platforms but without the need for simultaneous connection followed by activities supervised by the parents;
- carrying out synchronous, regular online activities related to objects of knowledge, according to technological availability;
- offering regular asynchronous online activities in relation to the contents, according to the technological availability and familiarity of the user;
- directed studies with parental supervision;
- exercises and homework according to the teaching materials used by the school;
- organising parent groups through instant messaging apps and others connecting teachers and families; and
- guidelines for families and monitoring of students. (Brasil, 2020, p. 7-8)

However, whatever possibilities of use of technology became unfeasible for the rural school we were investigating. The absence of effective government public policies excluded students living in rural life contexts from possibilities of access to digital means of emergency remote teaching (ERT).

During the pandemic at the Osvaldina school, the study materials were delivered every two weeks to the students' homes. Some students did not have internet access, or there was no stable connection to upload the files or video lessons (DC – 30/09).

In this same perspective, in parallel conversations in the first meeting, a student points out:

> ***Sophia****: I can't access [the internet], only when I come to school do I get to access it a little, or when I go to my sister's, who lives in town.*

Most of the students were unable to adapt to the teaching-learning process, especially those who attend the rural school, as a result of the difficulties of access for most students, because they do not have cell phones or computers with the memory capacity necessary to meet their study needs or the absence of that technological equipment in their homes. (Silva, Santos & Lima, 2020, p. 60)

In this sense, we decided to develop our research only when the in-person classes[5] resumed. However, this return also brought insecurity about the directions of the school process: new teaching modalities (blended teaching), new methodologies (active methodologies), new cultural demands for training (Gatti, 2020) and, also, the fear of new spread of the virus in Brazil.

However, with the face-to-face classes, the research activities collided with our second aspect, *the internet access at school*. According to Kenski (2015), the internet represents an essential item in school and needs to be inserted as an object of educational public policies.

The demand for internet access is in the National Education Plan (PNE 2014-2024), which emphasises that it is of paramount importance that schools have access to digital resources that enable the use of pedagogical practices in the teaching and learning process, with the computerisation of schools and universal access to the world wide web (Brasil, 2014). This practice also needs to consider the specificities of school environments so that it can develop pedagogical technologies that combine, in an articulated way, the organisation of time and didactic activities between the school and the community environment, considering the specificities of special education, rural schools, and indigenous and quilombola communities. (Brasil, 2014, p. 4)

For this, the Programa de Inovação Educação Conectada [Connected Education Innovation Programme] was instituted on November 23, 2017, through Decree N. 9.204, as one of the public policies for digital technologies in education systems. This decree provides that the programme aims to "support the universalisation of high-speed internet access and foster the pedagogical use of digital technologies in basic education" (Brasil, 2017). Thus, we note the existence of legislation aimed at access to digital resources in education networks, which should create the necessary conditions for their pedagogical use.

[5]State Decree N. 55.882, of May 15, 2021.

However, internet connection in Osvaldina school does not mean a quality connection, which was evident during the intervention.

Another recurring point in this category was the interference of the internet signal in the Powtoon software in almost all meetings, except in the first. There were problems loading the program tools, searches on other websites, and even misconfiguration of the slides, characters, objects, toolboxes, and texts that students had already entered into the program (DC post-intervention).

This internet oscillation made many students complain or call the researcher:

> ***AgroMatemática****: will we be able to put examples and music, teacher?*
>
> ***TEC Productions****: Teacher, it has frozen up and we can't insert the dolls; and the text boxes are not loading, either.*
>
> In the final conversation, one of the students highlighted instability as a negative point of the intervention process:
>
> ***Gra:*** *It was cool, except when the computers were slow because of the internet [connection], [...]*

Therefore, we emphasise the importance of having an internet that meets the demand in education networks, "to guarantee users an online experience according to their needs or, better said, a minimum condition of internet quality for a satisfactory and adequate user experience" (Bettega, Marin & Neto, 2020, p. 148). Thus, providing access to services allows us to enjoy the pedagogical possibilities provided by technology.

It is noteworthy that the school management unsuccessfully requested the internet provider service to verify the cause of instability in access. The answer given was that there was much demand and that they would investigate when possible, which, until the end of the research, did not happen.

The second element raised consists of the issues involving the *image in the context of technology*. In the group, there is a doubt about whether they should appear: sometimes, students want to be in evidence, and sometimes they do not.

As for not showing up, we noticed two moments in the research. At first, students feel embarrassed to be recorded in audio or video. When asking about the uses of the videos, we experienced the following:

> ***Researcher****: Do you like watching videos?*
>
> The students nodded.
>
> ***Researcher****: What types of videos do you watch? Have you ever produced any kind of video?*
>
> There was no return but whispering.
>
> ***Researcher****: And what do you expect from video production?*
>
> I noticed the students became somewhat silent. So I decided to end the recording. After that, we talked, and they preferred not to be recorded (DC- 30/09).

On the other hand, students expressed a desire to be seen and recognised on social networks. At the same time, previously described in the intervention, the group points out that

> [...] they use those apps [Tiktok and Kwai] also to produce videos for their social networks [Instagram, *YouTube*, etc.], but most of the time, they are "random" videos, that is, when they are at home accessing their social networks (DC- 30/09).

Given this fact, we see evidence related to the idea of belonging to a group (Lima et al., 2012). At the same time that they do not wish to be in evidence for something that others are not –the recording of audios– they aim to enter into 'usual' internet practices of the adolescent group –recording random videos for social networks.

In this sense, we emphasise that digital media have become the primary means for students to interact quickly and with several communities simultaneously. Thus, by strengthening "belonging to the virtual community, one can strengthen the identification [of the group] of adolescents" (Lima et al., 2012, p. 9). For the educational field, it would be up to us, educators, to think about how to use this space to problematise and enhance learning.

The third element listed is consistent with the *(non) mastery of technology*. The choice of the non in parentheses refers to our understanding that the group masters deeply certain relationships with technology, but not others.

Throughout the intervention, the students showed full mastery of the use of technology for entertainment.

> ***Taty****: Ah! YouTube is a way to be distracted, to pass the time. So I use it a lot.*
>
> *[...]*
>
> ***Aly****: I use social networks to watch dance video, choreography, games... The important thing is it must be funny.*

In addition to social networks and because of their registration, all students have an email account. The fact was perceived when the students needed to register on the Powtoon website.

We consider that such aspects are evidence of a process of virtualisation of reality (Borges, 2000). The author states that when technological means are used as a frequent daily practice, it is possible to obtain a process of interpretation of reality and thus promote acts of creation and invention (Borges, 2000). Thus, these technological entertainment resources are already part of the student's daily life. When used in school, the teacher can approach them to explore creation and invention as mechanisms in favour of the teaching-learning process in the classroom.

On the other hand, in the construction of school research on the internet, we perceive the students' difficulties in mastering the use of tools for this, as we see in the excerpt below:

> The initial idea was to make a word cloud with the concepts. However, we noticed that most used the same research site (*Wikipedia*), and so some answers were the same. That is why we chose the scheme (DC-30/09).

We also noticed that the surveys came as a copy-and-paste from the Wikipedia website. Or, as Nani would say:

> ***Nani****: Then I clicked on the first one that appeared and copied what was written there.*

Wikipedia is composed of a worldwide interconnected network, in different languages, with free and unlimited access. The site also allows user participation, i.e., it is possible to collaborate, add, or update new information. In this way, the site became accessible to everyone and is one of the most used in research, allowing interactions between users in access to all means of information.

So, how to trust the credibility of those contents? According to Christofoletti (2007, p. 4):

> [...] despite this system, there is no instance between the facts and the public that guarantees the validity of the information, and the receivers must decide by their own means whether the information deserves credibility and trust. This screening reaches more diffuse contours nowadays, a time of many forms of access to information catalysed by the internet.

In this conception, the reader or user must analyse and mine the information on the website and compare it with other sources when possible. In this sense, we visualised a possible role for school work: to create strategies for analysing information researched and seen on the internet. Thus, the subject can understand that digital media allow a series of results in a few seconds, but he/she is the one who must check the veracity (Cruz Júnior, 2019).

However, we realise that it is not enough to use entertainment resources. The internet in education must have a differentiated focus. Video, for example, may or may not be a digital resource of interest to students. Although they watch videos linked to social networks, regarding video classes, they emphasise:

> ***Researcher****: And video class, do you watch [it]?*
>
> ***Aly****: No, it's very boring! Some of the videos are very time consuming, sometimes it takes much time to load*.

It is crucial that the students find the video relevant so that the teaching and learning process becomes meaningful, instigating the students through different strategies. For this, the video must explore different audiovisual resources. According to Moran (1995, p. 28),

> The video also explores, and basically, the seeing, visualising, face the situations, the people, the landscapes, the colours, the spatial relations (near-distant, high-low, right-left, large-small, balance-imbalance).

To overcome this demand, students' authorship can be a possible path.

> ***Vine****: I didn't think I could make a video about the math content. I thought it would be very difficult to organise, but everything worked out well. It was nice!*

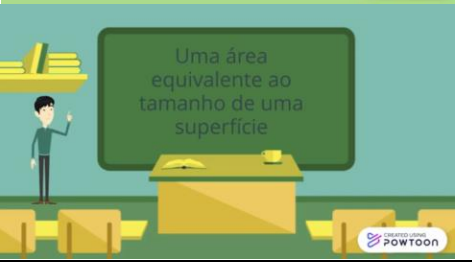
In this sense, we emphasise how important it is that students are protagonists of the creative process of videos and use these means to get into the learning process.

The last element of this category refers to the *video and the traditional lesson reproduction*. At this point, we highlight the teachers' centrality, the reproduction of the classroom environment and the video sequence. It is noteworthy that we inserted this element in this category because we visualised, in general, how technology can reproduce traditional practices in the classroom.

The aspect of centrality in the teacher is seen in the three videos, as we see in Table 7.

Table 7

Video excerpt

Group	Video excerpt
Produções MN	
AgroMatemática	
TEC Produções	

The idea of the teacher as the centre of this process is reinforced in some students' speeches:

> ***Sophia**: Let's use teacher Maicon explaining the content in the classroom with the desk and the board.*

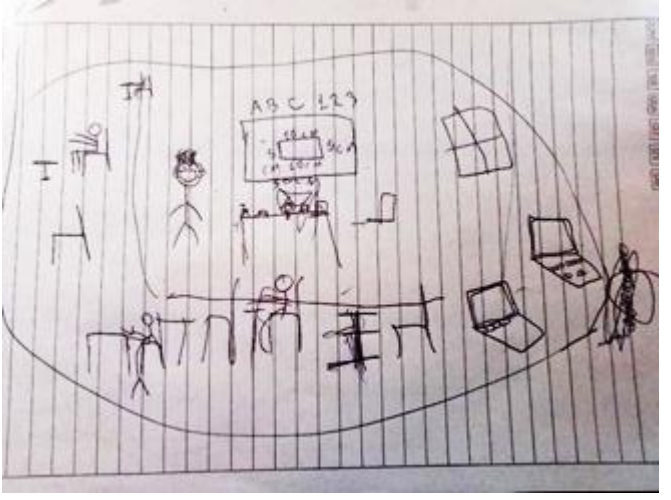
Such conception of the teacher as the centre of the class must be problematised to deconstruct the image of traditional teaching, in which only the teacher is the holder of knowledge. Thus, we emphasise that the learning process in the classroom needs to be student-centred. "In this process, the student becomes a knowledge cultivator, having the teacher as a mediator/facilitator of access to information" (Pinheiro & Batista, 2018, p. 78).

Also, in the previous table, we note that two of the videos use the classroom environment as a production context (*Produções MN* e *TEC Produções*). This use was intentional, as we see in the excerpt and the sketch of the following script:

> ***Taty**: We also wanted to put some characters that would be us attending the class, but I don't know whether we can do that on the program.*
>
> [...]

Figure 6

Sketch of the TEC Produções group script



We considered that this choice for video use is associated with the learning model to which the students are used and with the understanding that there is street knowledge and school knowledge (Carraher, Carraher & Schliemann, 1995). In this sense, we realised that we must problematise this relationship in future video productions, denaturalising that the only existing mathematics is school mathematics.

The last aspect we want to highlight in this category is the *video sequence*. We perceived that the three productions bring a similar mathematics teaching configuration and are based on a perspective questioned by the National Curriculum Guidelines (Orientações Curriculares Nacionais -OCN).

According to this document, two conceptions of teaching and learning mathematics occur in education systems, the first being fostered by students in their productions. This

> gives rise to the teaching standard "definition-examples-exercises", i.e., the introduction of a new concept would be given by its direct presentation, followed by many examples, which would serve as a standard, and to which students would refer at later times; the chain would be closed with the presentation of a large number of exercises, well known as "fixation exercises". (Brasil, 2006, p. 81)

Similar to this description, in TEC Produções, we see the video sequence in Table 8.

Table 8

TEC Produções Sequence

Stage	*TEC Produções*	Understanding
Definition		TEC Produções group starts the video with the authors' presentation, followed by the definition of area and perimeter; then, they distinguish the concepts,

Example **Application** **Resolution**		based on the area association to the surface and the perimeter to the contour. For this, they use the teacher's character to explain and exemplify the concepts and calculate through the example of a soccer field. Therefore, they relate to the school's soccer field, in which they could take measurements and use it as one of the applicabilities of the concept. And then they use a student's character to explain the practical situation of the resolution of how to calculate the area and the perimeter with the measurements they take in the court.

Table 9

AgroMatemática's sequence

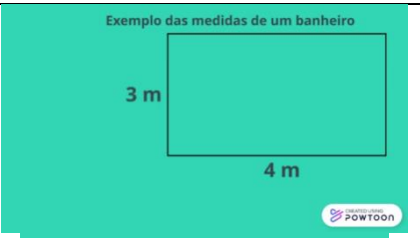
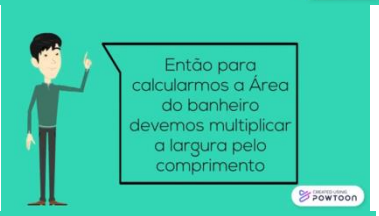
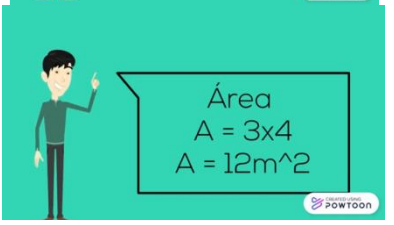
Stage	*AgroMatemática*	Understanding
Situation		The video of the AgroMatemática group begins with something directed to what they proposed from the beginning, the crop, in which they also use a

Definition		teacher's character to show a situation in which the area and perimeter are present. They define the concepts associated with geometric objects, i.e., the measurements of a given figure. Then they return with an example from the initial situation, entering values of the measures of a given soybean crop. And they apply the resolution of how to calculate the area and perimeter through the definition described by the group. In this production, the teacher is used along the process to define, explain, and exemplify the concepts related to the content.
Go back to the example		
Resolution		

Table 10

Produções MN sequence

Stage	***Produções MN***	Understanding
Definition		And the Produções MN group has a format

Example		similar to the TEC Produções group in the definition of the concept, in which the area is related to what fills the surface of a figure and the perimeter with its contour. In the example, they use the measurements of a bathroom and then how calculate the area and the perimeter with the values of the measurements. And finally, they use formula acquisition in the resolution of calculations. The teacher's character is also used to define, explain, and exemplify the concepts about the area and the perimeter.
How to calculate		
Resolution		

On the other hand, AgroMatemática sequenced its video from the ideas (Table 9).

Finally, Produções MN presented its video as in Table 10:

We observed that the definition is in evidence as the starting point of teaching the concept of area and perimeter, followed by examples of resolution and application. In this sense, we believe that this structure verifies the traditional model of class that students bring with them as an ideal mathematics teaching and that, even with the insertion of technologies, it can be repeated in the school context.

Thus, we agree with Borba, Scucuglia, and Gadanidis (2014) when they emphasise that technology is not enough for a new way to think about mathematics teaching in basic education. It is necessary that new ways of seeing, discussing, and producing knowledge come into action. Otherwise, we would only create new ways of saying the same.

Another possibility brought by the OCN (Brasil, 2006) would be

> [...] the opposite way, i.e., the learning of a new mathematical concept would take place by presenting a problem situation to the student, leaving the formalisation of the concept as the last stage of the learning process. In this case, it would be up to the student to build mathematical knowledge that allows solving the problem, having the teacher as a mediator and advisor of the teaching-learning process, responsible for the systematisation of new knowledge. (Brasil, 2006, p. 81)

Thus, the construction of mathematical knowledge through a systematisation carried out by the teacher-student partner would be emphasised, starting from problem situations. This practice is consistent with what we so long for in our schools, with participatory and critical adolescents that think about their lives and reality.

CONCLUSIONS

For this research, we brought notes related to the media resource as a tool in the teaching of the mathematical concept, seeking to analyse the contributions of the creation of videos in Powtoon to work with area and perimeter with 7th graders of elementary school in the rural area of São Borja/ RS.

We carried out this work in three stages, which were organised as follows: 1) Application of a questionnaire involving the theme area and perimeter with 7th-grade students; 2) Creation of the videos based on four moments, namely: a) Conversation with the students and presentation of the proposal, b) Research on the theme, c) Creation and completion of the videos, and, finally, d) Dissemination of the videos; and, in the last stage, we resumed 3) the questionnaire for an individual conversation about the answers obtained in the initial questionnaire.

Regarding the general guiding objective, we noticed significant changes in the concept of area and perimeter (through analysis) with the productions carried out by the students. This highlights the importance of the technological tool in the educational context when inserted into classroom practices, especially when it comes to a rural school, particularly the place of study, in which the quality of internet access needs improvement.

In our practice in the context of technology, we noticed that video production could awaken in the student something they did not imagine doing, playing a central role in creating videos and building mathematical knowledge.

AUTHORSHIP CONTRIBUTION STATEMENT

M.Q.F. conducted the field research and initial data analysis and J.C.P.M. guided the field research and constituted the final data analysis.

DATA SHARING STATEMENT

The data supporting the results of this study will be made available by the corresponding author (J.C.P.M.) upon reasonable request.

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